Scientific Excellence • Resource Protection & Conservation • Benefits for Canadians
Excellence scientifique • Protection et conservation des ressources • Bénéfices aux Canadiens

Abundance, Age, Size, Sex and Coded Wire Tag Recoveries for Chinook Salmon Escapements of Campbell and Quinsam Rivers, 1986-1988

R.C. Bocking, K.K. English and T.M. Webb

Department of Fisheries and Oceans
Fisheries Branch
#416, Suite 400-555 West Hastings Street
Vancouver, British Columbia V6B 5G3

April 1990

Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2065

Fisheries and Oceans Pêches et Océans

Canada

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1–900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901–1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426–1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent de problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 2065

April 1990

ABUNDANCE, AGE, SIZE, SEX AND CODED WIRE TAG RECOVERIES FOR CHINOOK SALMON ESCAPEMENTS OF CAMPBELL AND QUINSAM RIVERS, 1986-88

by

R.C. Bocking[1], K.K. English[1] and T.M. Webb[2]

for

Department of Fisheries and Oceans
Fisheries Branch
#416, Suite 400 - 555 West Hastings Street
Vancouver, B.C.
V6B 5G3

---

[1]LGL Limited, Environment Research Associates, 9768 Second Street, Sidney, B.C., V8L 3Y8
[2]ESSA Environmental and Social Systems Analysts Ltd., #705 - 808 Nelson Street, Vancouver, B.C. V6Z 2H2

90-05226/

(c) Minister of Supply and Services Canada 1990

Cat. No. Fs 97-4/2065E ISSN 0706/6473

Correct citation for this publication:

Bocking, R.C., K.K. English and T.M. Webb. 1990. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1986-1988. Can. MS Rep. Fish. Aquat. Sci. 2065 : x + 126 p.

TABLE OF CONTENTS

	Page
LIST OF FIGURES	v
LIST OF TABLES	vi
LIST OF APPENDICES	ix
ABSTRACT/RESUME	x
INTRODUCTION	1
STUDY AREA	2
METHODS	4
POPULATION ESTIMATION	4
Population Stratification	4
Potential Biases	5
Calculations	8
Strays	8
TAGGING	9
1986: Carcasses Ouplanted from Hatchery	9
1986 - 88: Carcasses Tagged in Situ	9
RECOVERY	9
CODED WIRE TAGGING AND RECOVERY	10
BIOLOGICAL AND PHYSICAL SAMPLING	12
RESULTS	13
TAGGING	13
1986: Carcasses Outplanted from Hatchery	13
1986 - 88: Carcasses Tagged in Situ	14
RECOVERY	14
POPULATION ESTIMATES	15
Carcass Tagging	15
AGE, LENGTH AND SEX COMPOSITION	16
CODED WIRE TAGGING AND RECOVERY	17
LIVE TAGGING POPULATION ESTIMATE	18
DISCUSSION AND CONCLUSIONS	19
POPULATION ESTIMATION	19
AGE, LENGTH AND SEX COMPOSITION	21
CODED WIRE TAGGING AND RECOVERY	22
SUMMARY	23
ACKNOWLEDGEMENTS	23
REFERENCES	23

TABLE OF CONTENTS (cont'd)

Page

APPENDIX A 93

APPENDIX B 102

APPENDIX C 109

APPENDIX D 118

LIST OF FIGURES

FIGURE Page

1. Map of the Campbell and Quinsam rivers study area 3

2. Escapement estimates and 95% confidence limits (Poisson distribution) for chinook salmon in the Campbell/Quinsam rivers system, 1988, using 4 different Petersen population estimators 20

LIST OF TABLES

TABLE Page

1. Summary of methods for the Campbell and Quinsam rivers chinook salmon enumeration programs, 1986-88 . . . 25
2. Summary of release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1986 . . . 26
3. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1986 . . . 27
4. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1987 . . . 28
5. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1988 . . . 29
6. Summary of recovery effort (number of days) for chinook salmon carcasses in Campbell and Quinsam rivers, 1986 . . . 30
7. Summary of recovery effort (number of days) for chinook salmon carcasses in Campbell and Quinsam rivers, 1987 . . . 30
8. Summary of recovery effort (number of days) for chinook salmon in Campbell and Quinsam rivers, 1988 . . . 30
9. Summary of tagging and release of used hatchery chinook broodstock carcasses and dead recovery in Campbell and Quinsam rivers, 1986 . . . 31
10. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam rivers, 1986 . . . 32
11. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam river, 1987 . . . 33
12. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam river, 1988 . . . 34
13. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on hatchery broodstock carcass release and recovery of carcasses, 1986 . . . 35
14. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1986 . . . 36
15. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1987 . . . 37
16. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1988 . . . 38
17. Age composition of Campbell River chinook salmon, 1986 (determined from dead recovery) . . . 39
18. Age composition of Quinsam River chinook salmon, 1986 (determined from dead recovery) . . . 40

LIST OF TABLES (cont'd)

TABLE Page

19. Age composition of Quinsam Hatchery chinook salmon, 1986 (determined from rack recovery) . . . 41
20. Age composition of Campbell River chinook salmon, 1987 (determined from dead recovery) . . . 42
21. Age composition of Quinsam River chinook salmon, 1987 (determined from dead recovery) . . . 43
22. Age composition of Quinsam Hatchery chinook salmon, 1987 (determined from rack recovery) . . . 44
23. Age composition of Campbell River chinook salmon, 1988 (determined from dead recovery) . . . 45
24. Age composition of Quinsam River chinook salmon, 1988 (determined from dead recovery) . . . 46
25. Age composition of Quinsam Hatchery chinook salmon, 1988 (determined from rack recovery) . . . 47
26. Petersen estimates, by age, of chinook salmon escapement to the Campbell River, Quinsam River, and Quinsam Hatchery, 1986 . . . 48
27. Petersen estimates, by age, of chinook salmon escapement to the Campbell River, Quinsam River, and Quinsam Hatchery, 1987 . . . 49
28. Petersen estimates, by age, of chinook salmon escapement to the Campbell River, Quinsam River, and Quinsam Hatchery, 1988 . . . 50
29. Age-length distribution of Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon, 1986 . . . 51
30. Age-length distribution of Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon, 1987 . . . 53
31. Age-length distribution of Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon, 1988 . . . 55
32. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1986 . . . 57
33. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1987 . . . 58
34. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1988 . . . 59
35. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1986 . . . 60
36. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1987 . . . 65
37. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1988 . . . 70
38. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1986 . . . 74
39. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1987 . . . 79
40. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery, by tag code, 1988 . . . 84
41. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1986 . . . 88

LIST OF TABLES (cont'd)

TABLE Page

42. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1987 89
43. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1988. 90
44. Summary of release and recovery of live tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1988 91
45. Summary of live tagging and recovery of chinook salmon in Campbell and Quinsam rivers and Quinsam Hatchery and Petersen estimates of escapement using three different sources of recovery information, 1988 92

LIST OF APPENDICES

APPENDIX Page

A1. Release of tagged chinook salmon carcasses in Campbell River, 1986 . . . 94
A2. Release of tagged chinook salmon carcasses in Quinsam River, 1986 . . . 95
A3. Recovery of tagged chinook salmon carcasses in Campbell River, 1986 . . . 96
A4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1986 . . . 97
A5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1986 . . 98
A6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1986 . . 99
A7. Total dead recovery and adipose clip recovery of chinook salmon in Campbell River, 1986 . . . 100
A8. Total dead recovery and adipose clip recovery of chinook salmon in Quinsam River, 1986 . . . 101
B1. Release of tagged chinook salmon carcasses in Campbell River, 1986. The carcasses were tagged in situ . . . 103
B2. Release of tagged chinook salmon carcasses in Quinsam River, 1986. The carcasses were tagged in situ . . . 104
B3. Recovery of tagged chinook salmon carcasses in Campbell River, 1986. The carcasses were tagged in situ . . . 105
B4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1986. The carcasses were tagged in situ . . . 106
B5. Sequential mark-recapture data for chinook salmon carcasses tagged in situ in Campbell River, 1986 . . . 107
B6. Sequential mark-recapture data for chinook salmon carcasses tagged in situ in Quinsam River, 1986 . . . 108
C1. Release of tagged chinook salmon carcasses in Campbell River, 1987 . . . 110
C2. Release of tagged chinook salmon carcasses in Quinsam River, 1987 . . . 111
C3. Recovery of tagged chinook salmon carcasses in Campbell River, 1987 . . . 112
C4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1987 . . . 113
C5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1987 . 114
C6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1987 . 115
C7. Total dead recovery and adipose clip recovery of chinook salmon in Campbell River, 1987 . . . 116
C8. Total dead recovery and adipose clip recovery of chinook salmon in Quinsam River, 1987 . . . 117
D1. Release of tagged chinook salmon carcasses in Campbell River, 1988 . . . 119
D2. Release of tagged chinook salmon carcasses in Quinsam River, 1988 . . . 120
D3. Recovery of tagged chinook salmon carcasses in Campbell River, 1988 . . . 121
D4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1988 . . . 122
D5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1988 . 123
D6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1988 . 124
D7. Total dead recovery and adipose clip recovery of chinook salmon in Campbell River, 1988 . . . 125
D8. Total dead recovery and adipose clip recovery of chinook salmon in Quinsam River, 1988 . . . 126

ABSTRACT

Bocking, R.C., K.K. English and T.M. Webb. 1990. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1986-1988. Can. MS Rep. Fish. Aquat. Sci. 2065 : x + 126 p.

Estimates of escapement were derived for the Campbell/Quinsam rivers system for 1986-1988 using carcass tagging as part of the chinook key stream program. The Petersen carcass tagging estimate of chinook escapement was 7,298 in 1986; 8,295 in 1987 and 13,750 in 1988. A second Petersen estimate of 18,073 chinook was derived in 1988 using live tagging. Males were predominantly age 4 and 5 while females were predominantly age 5. Escapement estimates are presented by river, sex, and age.

Escapements of adipose clipped chinook to the entire system were 1,902 in 1986; 1,830 in 1987 and 1,325 in 1988. These estimates are further stratified by age, sex and tag code. The total hatchery contribution to the escapements was estimated using coded wire tagged/adipose mark rates at release. In 1986, the hatchery contributed 59.0 % of the male chinook escapement and 60.2 % of the female escapement. In 1987 these contributions rose to 80.0 % and 68.4 % for male and female chinook escapements, respectively. The hatchery contribution increased further, in 1988, to 83.7 % for males and 89.3 % for females.

Key words: Campbell, Quinsam, chinook, key stream, escapement, coded wire tags, live tagging, carcass tagging.

RÉSUMÉ

Bocking, R.C., K.K. English and T.M. Webb. 1990. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1986-1988. Can. MS Rep. Fish. Aquat. Sci. 2065 : x + 126 p.

Dans le cadre du programme des cours d'eau clés du saumon quinnat, des estimations d'échappées pour la période 1986-1988 ont été obtenues pour le réseau des rivières Campbell et Quinsam à partir des carcasses marquées. Les valeurs estimées, par méthode Petersen appliquée aux carcasses marquées, ont été de 7 298 pour 1986, de 8 295 pour 1987 et de 13 750 pour 1988. L'utilisation de poissons marqués vivants a permis d'obtenir une estimation de Peterson de 18 073 quinnats pour 1988. Les mâles étaient surtout d'âges 4 ou 5 et les femelles d'âge 5. Les estimations des remontées sont présentées par rivière, sexe et âge.

Les échappées de quinnats à nageoire adipeuse rognée de l'ensemble du réseau ont été de 1 902 en 1986, de 1 830 en 1987 et de 1 325 en 1988. Ces estimations sont de plus ventilées par âge, sexe et code de marqueur. L'apport total des pisciculture aux remontées a été estimé à partir des rapports entre les poissons marqués par fils codés et ceux marqués par rognage de la nageoire adipeuse. En 1986, les poissons d'élevage représentaient 59,0 % des remontées de quinnats mâles et 60,2 % des remontées de quinnats femelles. En 1987, ces valeurs ont respectivement atteint 80,0 % et 68, 4 %. L'apport des poissons d'élevage s'est encore accrû davantage en 1988 où ces valeurs respectives ont été de 83, 7 % pour les mâles et de 89, 3 % pour les femelles.

Mot clés: Campbell, Quinsam, quinnat, cours d'eau clé, échappée, margueur en fill codé, marquage à l'état vivant et mort.

INTRODUCTION

The chinook salmon of the Campbell/Quinsam river system was selected as one of the indicator stocks for assessing the response of Pacific chinook salmon stocks to a new harvest management regime. The goal of the new management regime is to rebuild chinook stocks to historical levels. This "key stream" program began in 1984 in response to objectives set out in the Canada - U.S. Salmon treaty.

The major objectives of the key stream program are:

1) to accurately estimate chinook escapement on key streams;

2) to estimate harvest rates and contributions to fisheries and escapement based on coded wire tagged/adipose clip returns, including estimates of the total escapement of coded wire tags to the key streams system; and

3) to estimate the contribution of hatchery and natural production to the escapement.

Chinook escapements to the Campbell River have ranged from 750 to 8,000 since 1947 (Shardlow et al. 1986). Chinook escapement to the Quinsam River was negligible prior to the opening of Quinsam Hatchery in 1972, but has ranged from 1,000 to 2,000 in recent years.

This paper presents the results of the third, fourth, and fifth years (1986-88) of intense escapement monitoring and sampling of chinook salmon in the Campbell/Quinsam system. The 1984 and 1985 study results are presented in Shardlow et al., 1986 and Andrews et al., 1988, respectively. The 1986-88 escapements of chinook salmon were calculated using the adjusted Petersen method (Ricker 1975) by tagging carcasses to produce separate estimates for sexes and rivers and summing these to form a total estimate for the "in river" escapement of chinook. The total recovery of chinook salmon at the Quinsam Hatchery was then added to the "in river" estimates to produce a final escapement figure for the entire Quinsam/Campbell system. In 1988 only, the escapement of chinook to the Quinsam/Campbell system was also estimated using the adjusted Petersen method by tagging live chinook salmon in the Campbell River estuary and recovering the tagged chinook either as carcasses in the Campbell and Quinsam rivers, or as live recoveries at the Quinsam Hatchery.

Potential biases in the Petersen method, and the carcass tagging and live tagging approaches, and method of stratification are discussed. Assumptions for the methods used and the tests for biases caused by violations of assumptions are described in the methods section. The results section presents the population estimates, tests for bias in tagging and recovery, population composition (age, length, and sex) and the results of coded wire tagging studies. The results are then discussed with respect to other studies and recommendations are made regarding future studies.

To avoid confusion in terminology relating to tagging and marking, the word "tagging" as used in this report refers to operculum tagging and "marking" refers to marking of chinook juveniles with coded wire tags and clipped adipose fins.

STUDY AREA

The physical attributes of the Quinsam/Campbell drainage area have been described in detail by Andrews et al. (1988). The Campbell River originates east of the Vancouver Island Ranges and flows in an easterly direction for 9 km into Discovery Passage immediately north of the city of Campbell River, British Columbia (Fig. 1). The Quinsam River, a major tributary of Campbell River, flows in a northerly direction through a series of small lakes for approximately 30 km to its confluence with the main Campbell River approximately 3.8 km upstream of its mouth.

The drainage area of the Campbell River system is 1,460 km^2 and of the Quinsam River system is 265 km^2 (Andrews et al. 1988). Fish passage in Campbell River is blocked by natural falls and a hydroelectric dam 5.5 km upstream of the mouth. Approximately 27 km of the Quinsam are accessible to natural spawning but chinook spawning takes place primarily in the lower 4 km of the river (Shardlow et al. 1986). In 1988 and future years, more access for chinook salmon to the upper Quinsam River will be provided past the fence near Quinsam Hatchery.

Flows in the Campbell River are controlled by the John Hart Generating Station, located 5.5 km upstream of the mouth (Marshall et al. 1977) and vary from 1.2 m^3s^{-1} to 826.0 m^3s^{-1} (mean=96.0 m^3s^{-1}). Flows on the Quinsam are not controlled and vary from 0.9 m^3s^{-1} to 21.6 m^3s^{-1} (mean=9.0 m^3s^{-1}) (Shardlow et al. 1986).

Commercial development in the Campbell River estuary includes log booming, sawmills, shake mills, a seaplane base at Tyee Spit, and pleasure boat moorage (Andrews et al. 1988). Manmade islands have been constructed in the estuary in an effort to improve fish habitat (Levings 1986). The lower reaches of the Campbell have been modified due to the community of Campbell River (population approximately 18,000) which surrounds the lower 2 km of the river. Access to the Campbell is primarily by municipal roads and by the Campbell River Road, which runs along the south bank of the river.

Mining for coal is conducted in the headwaters of the Quinsam, and forest harvesting is conducted throughout the watershed (Andrews et al. 1988). There is easy access to the lower reaches of Quinsam River but upstream of the hatchery, access is more difficult (i.e. logging roads).

The Campbell/Quinsam river system supports four species of Pacific salmon as well as steelhead trout (Oncorhynchus mykiss). The salmonids, in order of abundance, are pink, chinook, chum and coho salmon (O. gorbuscha, O. tshawytscha, O. keta and O. kisutch, respectively). Chinook spawn in Campbell River upstream of the confluence with the Quinsam, and in the Quinsam from the mouth to the counting fence (Andrews et al. 1988). Coho spawn in the Quinsam River but not the Campbell, and chum and pink salmon that used to only spawn in the lower reaches of the Campbell now utilize the lower reaches of Quinsam River as well. Chinook start migrating into the Campbell in late August but mainly in October, and spawn from mid-October to mid-November, with peak spawning in early November (Andrews et al. 1988). Migration of chinook into the Quinsam is greatly influenced by rainfall, but usually occurs from late September to late November. Spawning is usually completed by late November or early December.

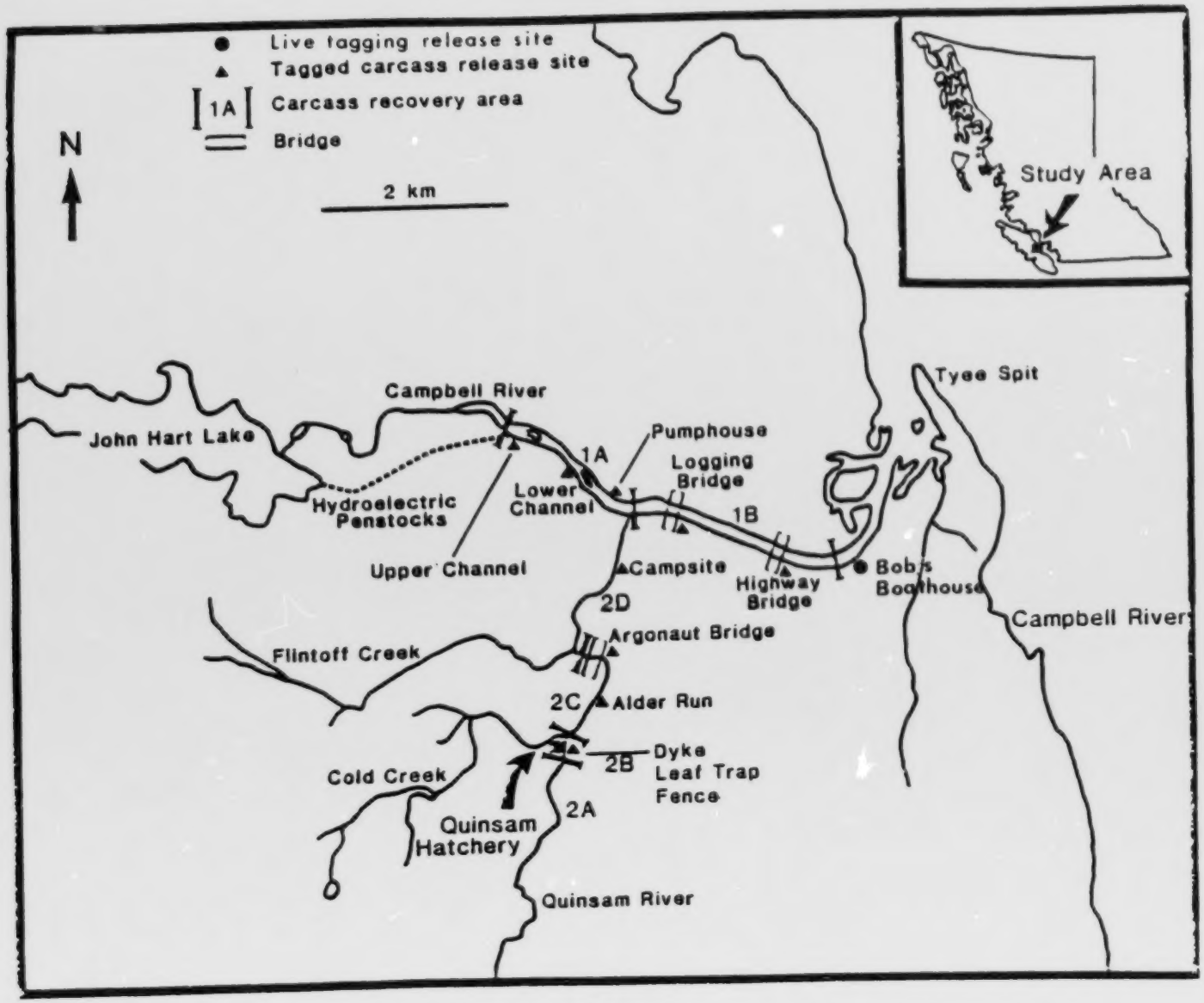

Figure 1. Map of the Campbell and Quinsam rivers study area.

The Quinsam Hatchery is located approximately 3.7 km upstream of the confluence with the Campbell River. A fence is located immediately upstream of the hatchery for broodstock collection (Fig. 1). Fish distribution and smolt production as well as river flows and water quality in the watershed was studied by Blackmun et al. (1985).

METHODS

Field work was conducted from mid-October to mid-December of each year by Quinsam Hatchery workers. A summary of methods for this study is presented in Table 1 and is described below.

POPULATION ESTIMATION

Chinook salmon were enumerated using the adjusted Petersen method (Ricker 1975, p. 78) by tagging chinook carcasses following natural spawning and recovering tags from the carcasses. In all years carcasses were tagged in situ during dead recovery efforts. In 1986, tagged hatchery broodstock carcasses were also released into the Campbell and Quinsam rivers as was done in previous years (Andrews et al. 1988). In 1988, an additional escapement estimate was derived using the adjusted Petersen method by tagging live chinook salmon in the Campbell River estuary and recovering tags from carcasses in the rivers and from live chinook recovered at the Quinsam Hatchery.

Population Stratification

Carcass Tagging:

There are four main ways of stratifying the carcass tagging and recovery data to produce a Petersen estimate of escapement:

1) sexes and rivers pooled;

2) sexes separate with rivers pooled;

3) sexes separate and rivers separate; and

4) sexes pooled with rivers separate.

Separate Petersen estimates may be calculated for each stratum and then summed to obtain an estimate of the whole population. By segregating the data into separate population strata, biases created by factors which affect the strata at different rates may be avoided. The main factors of concern are rates of tag application, recovery of carcasses, and tag loss. If carcasses in the

Campbell and Quinsam rivers do not mix following release of tagged carcasses in each river, forming two distinct groups for the purpose of enumeration, then there is a potential for substantial bias in unstratified estimates if tagging or dead recovery rates and effort are not identical. Similarly if the two sexes (and jacks) have different rates of tag application, recovery rates, or tag loss, then a single population estimate may be biased.

Due to the likelihood of factors affecting sexes and rivers at different rates, as documented by Andrews et al. (1988), Petersen estimates were stratified by sex and river in this study.

Live Tagging:

Live tagging in 1988 was designed to provide a single estimate of chinook escapement to the entire Quinsam/Campbell river system. Live tagging Petersen estimates were stratified by sex for the reasons mentioned above, but could not be stratified by river.

Potential Biases

Carcass Tagging:

Within a stratum, Petersen estimates using carcass tagging are potentially biased by violation of a number of assumptions. Seven of these assumptions, as discussed in Andrews et al. 1988, and modified from Ricker (1975) are presented below along with the consequences of violating them.

Tests used to determine whether biases were acting in this study are also presented and discussed below with respect to sex and river stratification of the Petersen estimate. Certain biases caused by methods of tagging, recovery, age determination, etc. are discussed in subsequent sections.

1) Tags are consistently applied in proportion to the available population and/or the distribution of recovery effort is proportional to the number of fish present in different river reaches and/or tagged fish become randomly mixed with untagged fish.

To obtain an accurate Petersen estimate, it is important to apply and/or recover tags in proportion to the available population. In 1986, tagged hatchery carcasses were released in river reaches in proportion to the available population as assessed by a preliminary foot survey of the distribution of natural carcasses in the two rivers before the carcass recovery operation began. However, there was no independent measure of the numbers of fish available for dead recovery, nor of the timing of the migration and termination of spawning. This is a fairly important problem as it affects the representativeness of sampling. In 1986-88, carcasses were tagged sequentially and in situ during recovery in addition to any other methods of tagging used during those years. Hatchery workers attempted to tag a consistent proportion of the number of fish examined during each recovery survey by tagging every second, untagged carcass, although this proportion still tended to vary considerably (usually 20 -60%) between days depending on the number of tagged carcasses recovered.

A related problem associated with rivers-separate escapement estimates is that tagged fish may stray between rivers. Apart from movement due to washout, tagged carcasses are not subject to straying in the same way as live fish. Calculations related to straying are described below. It is not possible to statistically test the extent of mixing of marked and unmarked fish using the data from this study, but movements of tagged fish are indicated by the location of recovery relative to the location of tagging. Tag release and recovery locations were grouped into river reaches to facilitate this comparison.

2) There is a negligible influx of spawners after the conclusion of tagging.

An influx of spawners following tagging could cause the Petersen calculations to overestimate or underestimate the true population depending on how they mixed with tagged fish. In 1986, the tagging program was designed to release tagged carcasses in four time periods as spawners migrated into the rivers as well as to tag carcasses in situ in the rivers during dead recovery. However, it is not possible to test this assumption with the data for the 1986 carcass tag outplants from Quinsam Hatchery. In 1986, 1987, and 1988, tagging continued in situ in the rivers almost daily throughout the spawning and die-off period.

3) There is no tag loss.

A high incidence of tag loss will cause Petersen calculations to overestimate the true population. Tag loss was determined by hole punching the operculum of all strap tagged carcasses and comparing the recoveries of double (hole plus strap) and single (hole only) tagged carcasses in 1988 and double and triple hole punches in 1987. A different number of opercular holes was used to distinguish carcasses tagged in the Campbell River from carcasses tagged in the Quinsam River. All secondary marks (opercular punches) were included in the tag recovery data.

4) All tags are recognized and reported on recovery after the conclusion of tagging.

In this study, no repitches were conducted to reexamine carcasses for missed tags and secondary marks, therefore it was not possible to evaluate tag non-reporting incident.

5) Recovery efforts are made on the same population as was tagged.

Dead recovery from a population other than the tagged population will cause Petersen calculations to overestimate the true population. Indications that tagging and recovery were conducted on different populations would be different age frequency and length frequency distributions among the two samples. Data were not taken to perform these tests.

6) There is adequate sampling to obtain a tag recovery rate which provides an accurate and precise population estimate.

A small number of tag recoveries in a stratum will cause Petersen estimates to have low precision. Petersen estimates are generally more reliable if a high proportion of the tagged fish are recovered in each stratum. In the absence of other sources of bias, approximately 25 to 75 recaptures will produce population estimates with 25% accuracy, with 95% confidence, for populations of 10^2 and 10^9 (Ricker 1975). Confidence intervals for the escapement estimates were calculated as described later in the calculations section of the methods.

7) Tagged carcasses are representative of the population and behave in a similar manner to untagged carcasses with respect to buoyancy, visibility, and decomposition.

Tagged carcass recoveries will not be representative of the population if tagged carcasses do not mix completely with untagged ones (see assumption 1), in which case the Petersen method may overestimate or underestimate the population. The thoroughness of mixing depends on how tagged carcasses are placed into the river and whether carcasses behave in a similar manner to untagged carcasses. It is not possible to statistically test the assumption of mixing with the data from this study.

Buoyancy and decomposition may be important factors causing differential behaviour of tagged and untagged carcasses especially if tagged carcasses become bloated with air during handling. Differences in tag visibility could cause preferential sampling of tagged carcasses, and result in an underestimate of the population. An attempt was made to circumvent this problem by using neutral colours to prevent increased visibility of tagged carcasses. It is not possible to test the assumption of similar visibility between tagged and untagged carcasses with the data from this study. The assumption of similar buoyancy and decomposition of tagged and untagged carcasses could be tested by comparing the tag recovery rate in the dead recovery with the rate at carcass weirs if such data were available.

Live Tagging:

All of the above mentioned assumptions apply to the live tagging of chinook in 1988. However, the potential for violation of some of these assumptions may differ from carcass tagging.

Assumption 1: Tags applied proportionally or recovery effort proportional to distribution of fish.

We have no way of testing whether the initial tagging of live chinook in the estuary was in proportion to the total population. For live tagging, the recovery effort was spread over the entire river system (including the hatchery) and the dead recovery effort was spread over the period of die-off. As much as possible this recovery effort was in proportion to the available population.

Assumption 2: Negligible influx of spawners after tagging completed.

With live tagging over a 2 week period, there is some chance for a significant influx of untagged spawners after the conclusion of tagging. If only the early portion of the run was tagged, then the recovery of tags would not be of constant proportion to the total population throughout the tagging period. This could bias the escapement estimate significantly upward.

Assumption 3: No tag loss.

Tag loss for live chinook was determined by opercular hole punching all tagged chinook with a hole combination distinct from the carcass tagging.

Assumption 7: Tagged chinook behave similarly to untagged chinook.

No tests were made to evaluate mortality rates, visibility, and detectability between tagged and untagged chinook.

Calculations

The Petersen estimate of each river stratum and sex was calculated as follows (Chapman's formula, cited in Ricker 1975, p. 78):

$$1) \quad P_{i,r} = \frac{(C_{i,r} + 1)(M_{i,r} + 1)}{(R_{i,r} + 1)}$$

where P is the population estimate, C is the total number of fish recovered, M is the total number of fish tagged, and R is the number of tagged fish recovered. The subscript i is the sex stratum and the subscript r is the river stratum.

Population estimates for sex and river (carcass tagging only) strata were summed to obtain a total population estimate:

$$2) \quad P_t = \sum_{1}^{i} \sum_{1}^{r} P_{i,r}$$

Confidence limits for each stratum population estimate were obtained using fiducial limits for the Poisson distribution as described by Ricker (1975, p79). The 95% confidence limits for the total escapement was then determined by assigning equal weights to all strata and summing the lower and upper confidence limits across strata.

Strays

In this study, tagged carcasses released in one river and recovered in the other river were considered to be strays. For the purposes of the carcass tagging Petersen calculations, the total number of strays from the Quinsam River found in the Campbell River was estimated by expanding the observed number of tagged strays as follows:

$$3) \quad \begin{array}{l}\text{Expanded No.} \\ \text{tagged strays} \\ \text{from Quinsam}\end{array} = \begin{array}{l}\text{No. of} \\ \text{tagged strays} \\ \text{from Quinsam}\end{array} \times \frac{\text{No. of tags applied (M)}}{\text{No. of tags recovered (R)}}$$

No straying occurred from the Campbell River to the Quinsam River. This expanded number of tagged strays from the Quinsam to the Campbell was then used to estimate the number of tagged fish available in the Campbell River.

4) Tagged fish available in Campbell = Tags released in Campbell + Tagged strays from Quinsam to Campbell (expanded)

The above equation provides the estimate for the number of tagged fish available for recapture ($M_{i,r}$) used in equation 1.

TAGGING

1986: Carcasses Outplanted from Hatchery

Tagging was conducted by a crew of one or two hatchery workers. In 1986, tagged carcasses from Quinsam Hatchery broodstock were released on four separate dates in each river. Releases were made at five sites in Campbell River and seven sites in Quinsam River to achieve a tag release number of 50 fish per river per release date (Table 2; Appendix A, Table A1 and A2; Fig. 1). The distribution of tag releases was designed to match that of the spawning population which was ascertained by a foot survey of carcasses of both rivers prior to commencing the dead recovery program.

Carcasses from Quinsam Hatchery broodstock were tagged with cattle ear tags (Kurl-lock tags manufactured by Ketchan Manufacturing Sales Ltd., Ottawa, Ontario, Canada) of neutral colours which were attached to the operculum of the carcass.

1986 - 88: Carcasses Tagged in Situ

Tagging in 1986, 1987, and 1988 was conducted in tandem with the dead recovery effort. This enabled the tagging effort to be spread evenly throughout the recovery period. The number of tags applied increased each year and were significantly higher than tag outplanting levels from Quinsam Hatchery in 1986 (Table 3, 4, and 5).

RECOVERY

Hatchery crews that conducted dead recovery were composed of two to six workers each day. Tables 6-8 show the number of days spent in dead recovery effort for each area in each river. The recovery effort on the Campbell was fairly consistent between years (19 - 26 days). The recovery effort in the Quinsam River tended to be considerably lower (12 - 22 days) than for the Campbell. However, this is because it takes longer to complete a survey in the Campbell river than in the Quinsam and does not necessarily reflect significantly different levels of effort. The number of person days used in the surveys and the amount of area covered during each survey were not available.

Recovery crews were instructed to dead pitch and count all available carcasses and record and keep all operculum tags. In 1986, crews were intentionally not told where tagged carcasses had been released, so that they would not spend more time examining these areas than

other ones for tagged carcasses. In 1987 and 1988, crews attempted to keep their recovery effort as complete and consistent throughout the study period. Dead chinook were recovered from the Campbell and Quinsam rivers by three methods:

1) recovery crews searched the banks and shallow reaches of the rivers on foot and from a boat;

2) a SCUBA diver recovered carcasses from deep pools in the lower reaches of the Campbell and Quinsam rivers; and

3) live recoveries at the Quinsam Hatchery rack.

Each carcass was examined for the presence of a cattle ear tag and missing adipose fin. Heads were removed from adipose clipped fish for sampling of CWTs. Data collected from the carcasses is described in the biological and physical sampling methods section. All recovered chinook carcasses were cut in half to prevent repeat enumeration and sampling. The exception to this rule were those carcasses tagged during the recovery effort in 1986, 1987, and 1988. The carcasses were released at the same location as they were tagged. All tagged recaptured carcasses were cut in half.

For the purposes of the Petersen mark-recapture estimates, only carcasses recovered after the first day of tagging were included in the values of C and M. It was assumed that one day was necessary to allow sufficient mixing between tagged and untagged carcasses.

Other calculations relating to the dead recovery were as follows:

9) $$\text{Tag rate} = \frac{R}{C}$$

where tag rate is an estimate for the proportion of the population tagged.

10) $$\text{Tag recovery rate} = \frac{R}{M}$$

where the recovery rate is an estimate of the proportion of tagged fish recaptured.

CODED WIRE TAGGING AND RECOVERY

Juvenile chinook from the 1980 - 1985 brood years were marked with binary coded wire tags (CWT) descrit d by Jefferts et al. (1963) using standard methods (Armstrong and Argue 1977). Adipose fins of ded wire tagged juveniles were clipped prior to release of the fish.

In the dead recovery program, adipose fin clips were used to flag the presence of CWTs in returning adults. Heads from all adipose clipped fish recovered in the dead pitch were taken to the Quinsam Hatchery where CWTs were removed and decoded or were sent to the Tag Dissection Laboratory in Vancouver for this purpose.

Estimating the total number of CWT returns from each of the brood years, and for each tag code is a three step process (Andrews et al. 1988):

1) determining the appropriate samples and population strata to use for estimating the overall adipose clip rate (using either the mark rate at hatchery release or that found in the dead pitch or some combination of the two based on what is the most representative sample);

2) determining the proportion of the population examined to produce the observed number of adipose clips. This is then used to calculate the total number of adipose clips estimated to be in the escapement; and

3) allocating the total number of adipose clips estimated to be in the escapement among the tag codes in proportion to those successfully decoded.

If we assume that the survival of unmarked hatchery fish was equal to or greater than that of marked fish, this method estimates the minimum hatchery contribution to the escapement.

Adipose clipped fish were enumerated separately for males and females in the Campbell and Quinsam rivers and in the Quinsam Hatchery to correspond with the stratified Petersen estimates and rack recovery. The recovery of jack chinook was included with the adult male recoveries in this analysis. The dead recovery samples were used to estimate the total number of adipose clipped fish in the escapement, stratified by river (and hatchery) and sex:

$$11)\quad EAD_{i,r} = \frac{OAD_{i,r}\, P_{i,r}}{C_{i,r}}$$

where EAD is the estimated number of adipose clips, OAD is the number of adipose clips observed, C is the number of fish examined, P is the Petersen population estimate, and i and r are subscripts denoting sex and river.

Given an estimate of the number of adipose clips escaping to each portion of the system, the escapement of each tag code can be estimated by allocation to tag codes based on their relative frequency in the sample of decoded tags:

$$12)\quad EAD_{i,r,tc} = \frac{(EAD_{i,r})(OAD_{i,r,tc})}{NDT_{i,r}}$$

where tc is a subscript denoted tag code, and NDT is the number of decoded tags.

This approach of first estimating adipose clipped fish and then allocating these among the successfully decoded CWTs assumes that any adipose clipped fish not decoded were once marked but lost their coded wire tag for some reason. If this assumption is incorrect, the calculated number of hatchery origin fish would be biased upwards. It is possible, especially in the dead pitch, that some fish identified as hatchery releases by missing adipose fins may be natural fish that have lost their adipose fins through some other means, e.g. carcass decomposition. If decomposition of adipose fins is occurring then the adipose clip rate in the dead pitch should be higher than that observed in tagging. This was not tested.

The hatchery contribution to each year's escapement was calculated by comparing the escapement of each tag code with the total escapement broken down by river (and hatchery), sex, and age class:

$$13)\quad EHC_{i,r,tc} = \frac{(EAD_{i,r,tc})(RM_{tc} + RU_{tc})}{RM_{tc}}$$

where EHC is the estimated hatchery contribution, RM is the number of chinook released with CWTs in brood year t, and RU is the number of chinook released without CWTs in brood year t.

These estimates of hatchery contribution by tag code were then summed to give the hatchery contribution of all tag codes to the entire escapement, stratified by river, sex and brood year:

$$14)\quad EHC_{i,r,t} = \sum_{1}^{n} EHC_{i,r,tc}$$

where n is the number of tag codes for a given brood year t.

Due to the potentially different ages at maturity of males and females, it is important that allocation of adipose clipped fish to tag codes is carried out separately by sex whenever possible. The sex of all fish sampled for CWTs was recorded so that it was possible to estimate the total escapement of tag codes by sex (males included jacks).

BIOLOGICAL AND PHYSICAL SAMPLING

Biological sampling during dead recovery included scales for age determination, length, sex, presence of secondary marks (hole punches in opercular) and presence of an adipose clip. Postorbital-hypural length was recorded from approximately 50% of the carcasses (marked and unmarked fish) in the Campbell and Quinsam rivers. Males were considered to be jacks when their length was less than 550 mm, however, this was often done without a measuring tape and so some small males were incorrectly classed as jacks. Because of this problem and because of

small sample sizes for jacks, length data on jacks was grouped in with adult males. Scale samples were taken from the same unmarked fish as length samples. Some adipose clipped fish (CWT) were also sampled for age (from decoding) and lengths. A scraping of scales was placed in a labelled plastic envelope and the individual scales from each fish were mounted in scale books at the hatchery. Scales were aged at the Department of Fisheries and Oceans scale laboratory in Vancouver. Heads were removed from adipose clipped fish and saved for CWT extraction and decoding.

Ages were read only when a portion of the previous annulus was present and scales were not regenerated. Scales were classified as unreadable if the scales had regenerate centres, they were resorbed, or if they were mounted upside down. Ages were recorded for fish for which there were at least two scales that could be read for both marine and freshwater ages. In this report, the first numeral of the age recorded indicates the year of total life and the decimal point and following numeral indicates the year of life in which the fish migrated to the ocean. The aging system follows that described by Gilbert and Rich (1927).

The age composition determined with the available samples is valid only if age sampling was random and there was no bias in readability of scales with age. Ages of older fish are usually more difficult to read than those of young fish because scales of older fish usually undergo more resorption and regeneration. The data were examined for this potential bias using a chi-squared test to compare the mean lengths of known and unknown age males and females. The dead recovery sample was used to determine the age and length composition of the population. Because of problems in distinguishing jacks from adult males, age and length information for jacks was grouped with males.

The population of each age class was then determined by allocating portions of the Petersen estimate to age classes according to the age composition determined from scale samples.

The sex ratio was determined for each river by sexes and rivers separate Petersen estimates. This method provides a valid sex ratio. The test for potential differences in tag loss was described in the tagging methods section. Tag recognition is not likely to be biased by sex, although it is not possible to test this potential bias with the data in this study.

RESULTS

TAGGING

1986: Carcasses Outplanted from Hatchery

In 1986, a total of 200 chinook broodstock carcasses were tagged at Quinsam Hatchery and released into Campbell River. Fifty tagged carcasses were distributed on each of October 19, October 26, November 3, and November 9 to five locations (Table 2; Appendix A1; Fig. 1). Similarly, a total of 200 broodstock carcasses were released from Quinsam Hatchery into Quinsam

River on October 20, October 27, November 3, and November 10 to seven locations (Table 2; Appendix A2; Fig. 1).

1986 - 88: Carcasses Tagged in Situ

In 1986, 595 chinook carcasses were tagged and released continuously throughout the spawning period from October 16 to November 18 in the Campbell River and 152 carcasses were tagged and released from October 17 to November 19 in the Quinsam River (Table 3; Appendix B1 and B2).

In 1987, 524 chinook carcasses were tagged and released continuously throughout the spawning period from October 19 to November 19 in the Campbell River and 409 carcasses were tagged and released from October 19 to November 23 in the Quinsam (Table 4; Appendix C1 and C2).

In 1988, 450 carcasses were tagged and released throughout the spawning period from October 17 to November 23 in the Campbell River and 974 were released from October 17 to December 5 in the Quinsam (Table 5; Appendix D1 and D2). Tagging effort in 1987 and 1988 was distributed throughout both rivers. Tables 2, 3, 4 and 5 summarize the daily totals of chinook carcasses tagged in each year.

RECOVERY

Surveys to recover carcasses in 1986 began on October 20 in the Campbell River and on October 21 in the Quinsam River and continued until November 21 and 19, respectively (Appendix B3 and B4; Fig. 1). In 1987, chinook carcasses were recovered from October 23 to November 27 in the Campbell River, and from October 26 to November 30 in the Quinsam River (Appendix C3 and C4). In 1988, recovery of carcasses occurred between October 20 and November 29 in the Campbell River and between October 19 and December 9 in the Quinsam (Appendix D3 and D4). On some days, some reaches in each river were surveyed more frequently than others. Tables 6, 7 and 8 summarize the number of days spent recovering chinook carcasses in each area of the rivers for each year.

Sequential daily totals of the number of carcasses recovered, the number of tags applied, and the number of tags recovered, stratified by year, river, and sex are presented in Appendix A5, A6, B5, B6, C5, C6, D5 and D6. Note that the total number of fish examined is greater than the number of fish examined (C in the Petersen formula) because recoveries on or before the first day of tagging cannot be included. Subsequent references in this report to the number of carcasses recovered are for the number of recoveries used in the Petersen estimate.

In 1986, using the in situ tagging method, a total of 2356 chinook carcasses were examined in the Campbell River (985 males, 1332 females, and 39 jacks; Table 10). This number included 338 tag recoveries (121 males, 209 females and 8 jacks), one (male) of which was a stray from the Quinsam River. In the Quinsam River, a total of 692 chinook carcasses were examined (314 males, 339 females, and 39 jacks; Table 10). This included 84 tag recoveries (22 males, 59 females, and 13 jacks). In both rivers, more females than males were

recovered, and fewer jacks were retrieved than either males or females. Fewer tagged fish were recovered using hatchery broodstock carcasses for tagging (Table 9).

In 1987, 1446 chinook carcasses were examined in the Campbell River (589 males, 793 females, and 64 jacks; Table 11). This included 290 tag recoveries (102 males, 183 females and 5 jacks), three (all female) of which were strays from the Quinsam River. In the Quinsam River, a total of 1157 chinook carcasses were examined (235 males, 584 females, and 338 jacks; Table 9). This included 230 tag recoveries (47 males, 147 females, and 36 jacks). As in 1986, and in both rivers, more females than males were recovered, and fewer jacks were retrieved than either males or females.

In 1988, a total of 1106 chinook carcasses were examined in the Campbell River (481 males, 548 females, and 77 jacks; Table 12). This number included 183 tag recoveries (77 males, 102 females and 4 jacks), 20 (6 males, 13 females, and 1 jack) of which were strays from the Quinsam River. In the Quinsam River, a total of 2316 chinook carcasses were examined (1035 males, 1083 females, and 198 jacks; Table 12). This included 436 tag recoveries (174 males, 250 females, and 12 jacks).

The carcass tag recovery rate was similar in the Quinsam (55%, 56%, and 45% in 1986, 1987, and 1988, respectively; Tables 10, 11 and 12) and in the Campbell (56, 55%, and 41% in 1986, 1987, and 1988, respectively). Within each river, the recovery rates of adult male and female tagged carcasses were not significantly different (Campbell (all years): contingency x^2= 5.28, df=3, $p>0.05$; Quinsam (all years): contingency x^2= 0.28, df=3, $p>0.05$). However, the recovery rate of jacks when compared to adult males was significantly different (Campbell (all years): contingency x^2= 11.59, df=3, $p<0.01$; Quinsam (all years): contingency x^2= 8.59, df=3, $p<0.05$).

POPULATION ESTIMATES

Carcass Tagging

The parameter values used in the derivation of the Petersen escapement estimate, stratified by year, river, and sex are given in Tables 13 through 16. The 1986 chinook escapement to the Campbell River and Quinsam River, as estimated using a simple Petersen estimate from hatchery broodstock carcass tagging, was estimated at 4762 and 745 fish respectively (Table 13). Sex specific estimates and 95% confidence limits for both rivers are also shown in Table 13. The total escapement to the Campbell/Quinsam river system in 1986, including hatchery rack recoveries, was estimated to be 7392 with 95% confidence limits of 5871 and 9486 fish (Table 13).

In 1986, in situ carcass tagging was also used to derive a Petersen estimate of the population. Using this method, the 1986 chinook escapement to the Campbell River and Quinsam River was estimated at 4150 and 1263 fish respectively (Table 14). Sex specific estimates and 95% confidence limits for both rivers are also shown in Table 14. The total escapement to the Campbell/Quinsam river system in 1986, including hatchery rack recoveries, was estimated to be 7298 with 95% confidence limits of 6300 and 8654 fish (Table 14). This is slightly less than the estimate derived above using hatchery broodstock carcasses and the confidence limits are

somewhat tighter. However, the river specific escapement estimates are substantially different. Using in situ carcass tagging resulted in a much higher number of chinook in the Quinsam River than was the case for the hatchery broodstock carcass tagging and release.

The 1987 chinook escapement to the Campbell River and Quinsam River, was estimated to be 2744 and 2188 fish respectively (Table 15). The breakdown of these totals among sexes for both rivers are also shown in Table 15. The total escapement to the Campbell/Quinsam river system in 1987, including hatchery rack recoveries, was estimated to be 8295 with 95% confidence limits of 7306 and 9745 (Table 15).

The 1988 escapement to the Campbell River and Quinsam River, was estimated to be 3153 and 5311 fish respectively (Table 16). The breakdown of these totals among sexes for both rivers are also shown in Table 16. The total escapement to the Campbell/Quinsam river system in 1988, including hatchery rack recoveries, was estimated at 13750 with 95% confidence limits of 12046 and 16471 fish (Table 16). This represents a significant increase in escapement over the previous 2 years.

The distribution of fish between the 2 rivers and the Quinsam Hatchery changed significantly over the 3 years of this study. In 1986, using in situ carcass tagging, the percent composition of the total escapement between the three areas (Campbell River : Quinsam River : Quinsam Hatchery) was 57:17:26. In 1987 and 1988, this composition changed to 33:26:41, and 23:39:39, respectively. This indicates a relative drop in the number of chinook returning to the Campbell River and a corresponding increase in the number of returns to the Quinsam River and Hatchery.

AGE, LENGTH AND SEX COMPOSITION

Nearly all of the fish sampled in the Campbell and Quinsam rivers were ocean-reared; i.e. they left the river to rear in the ocean during their first year of life and are termed sub-ones in this report (Tables 17-25). However, there were occasional occurrences in both rivers of fish that were reared in freshwater (sub-twos; Table 17, 20 and 23). Total ages of Campbell and Quinsam river chinook ranged from 2 to 7 years (Tables 17-25). The dominant age-group in the Campbell River was age 5 years (both sexes) except in 1988 when returning males were predominantly age 4 (Tables 17, 20, and 23). In the Quinsam River and the hatchery, the dominant male age group was 4 year olds in 1986 and 1988, and 3 year olds in 1987 (Tables 18, 19, 21, 22, 24, and 25). Females throughout the system were predominantly age 5, except in 1988 when they were mostly age 4.

Summaries of mean lengths by age are presented in Tables 17 through 25. In these tables, the total mean length (all ages) is weighted according to the number of fish sampled. Over the 1986-88 period, Campbell River males and females (mean postorbital-hypural length for males = 797 - 804 mm; females = 833 - 848 mm) were generally larger than Quinsam River fish (males = 687 - 784 mm; females = 799 - 810 mm) although, for any one year, the 95% confidence intervals of the mean lengths overlapped the mean, indicating that these differences were not significant between the two rivers. The mean length of chinook returning to the Quinsam Hatchery tended to be even lower than for the Quinsam River (Tables 17, 18, and 19).

Females tended to be larger in length than males in all years and all parts of the Quinsam/Campbell system.

There appeared to be no significant difference, as suggested by overlapping 95% confidence intervals, between the mean length of chinook that were not aged and the weighted (all ages) mean length of aged chinook (Tables 17 - 25).

The population escapement, stratified by age class, is shown in Tables 26, 27, and 28 for Campbell/Quinsam river system chinook in 1986, 1987, and 1988, respectively. In 1986, the sex ratio of males (including jacks)/females was 0.87 in the Campbell River, 1.16 in the Quinsam River, and 1.36 in the Quinsam Hatchery (Table 26). In 1987, these sex ratios were 1.13 in the Campbell River, 1.47 in the Quinsam River, and 1.95 in the hatchery (Table 27). In 1988, the ratio of males/females was 1.09 in the Campbell River, 1.55 in the Quinsam river, and 1.45 in the Quinsam Hatchery (Table 28).

Age-length distributions for chinook returning to the Campbell River, Quinsam River, and Quinsam Hatchery in 1986, 1987, and 1988 are shown in Tables 29, 30, and 31. From these tables, it appears that jacks (age 2 males) tend to be less than 500 mm in length.

CODED WIRE TAGGING AND RECOVERY

Coded wire tagged (adipose clipped) juvenile chinook released into the Campbell and Quinsam rivers from the 1980 to 1985 brood years were captured in the dead recovery programs in 1986-88 (Appendix A7 and A8; Appendix C7 and C8; Appendix D7 and D8).

The results of coded wire tag returns are presented below for the Campbell and Quinsam rivers and the Quinsam Hatchery. Information includes the following:

1) the raw data and mark rates for the calculations (Tables 32, 33, and 34);

2) estimates of the total escapement of adipose clips (Tables 32, 33, and 34);

3) the observed and estimated escapement of adipose clips by tag codes, and the hatchery contribution to the escapement for each tag code (Tables 35, 36, and 37); and

4) the estimated hatchery contribution to the escapement by age class (Tables 38, 39, and 40).

In 1986, there were 608 adipose clipped chinooks recovered in the Campbell River dead pitch, 237 in the Quinsam River dead pitch, and 538 at the hatchery rack (Table 32). The adipose clip mark rate in the Quinsam was moderately higher than the mark rate in the Quinsam Hatchery which was moderately higher than in the Campbell. The total estimated adipose clips to Campbell River, Quinsam River, and Quinsam Hatchery were 1061, 303, and 538, respectively (Table 32).

In 1987, there were 364 adipose clipped chinooks recovered in the Campbell River dead pitch, 300 in the Quinsam River dead pitch, and 621 at the hatchery rack (Table 33). The adipose clip mark rate in the Campbell and Quinsam rivers were similar but slightly higher than in the hatchery returns. The total estimated adipose clips to Campbell River, Quinsam River, and Quinsam Hatchery were 683, 558, and 621, respectively (Table 33).

In 1988, there were 135 adipose clipped chinooks recovered in the Campbell River dead pitch, 245 in the Quinsam River dead pitch, and 421 at the hatchery rack (Table 34). The adipose clip mark rate in the Quinsam River was slightly lower than the mark rate in the Campbell River but higher than in the hatchery. The total estimated adipose clips to Campbell River, Quinsam River, and Quinsam Hatchery were 375, 550, and 421, respectively (Table 34).

Results from the decoding of CWTs from the Campbell and Quinsam rivers and the hatchery rack are shown in Tables 35-40. Any CWT fish recovered in Campbell River which were released from another river were excluded from the analysis. In 1986, 532 CWT heads from adipose clipped fish in the Campbell River were decoded, 205 were decoded from the Quinsam River, and 481 were decoded from hatchery returns (Table 35). In 1987, 324 CWT heads from adipose clipped fish in the Campbell River were decoded, 257 were decoded from the Quinsam River, and 496 were decoded from hatchery returns (Table 36). In 1988, 117 CWT heads from adipose clipped fish in the Campbell River were decoded, 209 were decoded from the Quinsam River, and 400 were decoded from hatchery returns (Table 37). Age 2 males (jacks) were included with all other adult males for this analysis.

The allocations of the total escapement of adipose clips to tag codes recovered in each river are shown in Tables 38, 39, and 40. The estimated hatchery contributions to the 1986 escapement of chinook to the Campbell River, Quinsam River, and Quinsam Hatchery were 2115, 584, and 1651, respectively (Table 38). In 1987, the estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery were 2056, 1946, and 2247, respectively (Table 39). In 1988, the estimated hatchery contributions to each river and hatchery escapement were 2581 to the Campbell, 4761 to the Quinsam River, and 4486 to the Quinsam Hatchery (Table 40).

The hatchery contribution to the total escapement of chinook each year, by age class is presented in Table 41, 42, and 43. In 1986, the hatchery contribution to the entire Quinsam/Campbell system was estimated to be 59.0% for males and 60.2% for females. This increased to 80.0% for males and 68.4% for females in 1987. In 1988, the estimated hatchery contributions to the entire system increased again to 83.7% for males and 89.3% for females.

LIVE TAGGING POPULATION ESTIMATE

In 1988, a live tagging program was initiated for comparison to the carcass tagging program. The release and recovery data for this program are presented in Table 44. A total of 414 chinook salmon were tagged near Bob's Boathouse in the Campbell River estuary using seines for capture. Fish were tagged in proportion to their catch rates. Recoveries of tagged fish were then made during subsequent dead recovery efforts on the Campbell River and Quinsam River, and live recovery at the hatchery rack. A total of 21 tag recoveries were made between October 18 and October 21 in the Campbell River (Table 44). Field crews recovered 40 live tags

in the Quinsam River between October 17 and November 24. At the hatchery rack, 138 live tagged chinook salmon returned.

Three different Petersen estimates were generated using live tagging data and three different sources of recovery data. For method A, only the recoveries of live chinook salmon at the Quinsam hatchery were included in the Petersen estimate. The Petersen estimate for the Campbell/Quinsam system using this method was 15490 (Table 45). Method B only used recoveries from the dead pitches conducted in Campbell and Quinsam rivers. This method resulted in a Petersen escapement estimate of 22867 chinook. Lastly, all recovery data from the Quinsam Hatchery and the dead pitches in both river were combined in Method C to derive a Petersen escapement estimate of 18703 chinook. Figure 2 shows the Petersen escapement estimates for each of the above methods and the estimate derived using carcass tagging (Method D), along with 95 % confidence limits.

Tag recovery rates for the live tagging program were higher (average across sexes = 51.0%) than for the carcass tagging program (average across sexes = 42.8%).

DISCUSSION AND CONCLUSIONS

POPULATION ESTIMATION

Several potentially important sources of bias in Petersen estimates were circumvented by stratifying the populations of each river by sex. In this study, there were factors that affected sexes differentially, as indicated by differences in the sex ratios obtained in hatchery seining for broodstock, dead recovery, and Petersen estimates. In this study, a higher proportion of females were recovered in the dead pitch surveys each year than males. Andrews et al. (1988) found similar differences in the sex ratios between dead pitch recoveries in both rivers in 1986, as did Shardlow (1986) in 1984-85. Higher proportions of females than males have also been observed in spawning ground dead pitches for sockeye (Petersen 1954), pinks (Ward 1959), and coho (Eames and Hino 1981, and Eames et al. 1981). Hence, it is important to stratify escapement estimates on the Quinsam/Campbell by sex.

Potentially important sources of bias in Petersen estimates were also circumvented by stratifying the estimate by river. However, there was no significant difference between the tag recovery rates in the Campbell and Quinsam rivers.

A high degree of straying between rivers by live-tagged fish was circumvented by the use of tagged carcasses. However, one factor which could have produced a serious bias in the carcass tagging Petersen estimate is the incomplete mixing of tagged carcasses with the rest of the carcass population, particularly in deep pools, where many carcasses may have been immobilized. Biases due to incomplete mixing can be reduced if tagging and recovery effort is conducted in proportion to the distribution of fish. Conducting tagging operations in tandem with the recovery surveys in 1987 and 1988 is more likely to achieve this than by tagging and releasing carcasses at set points in the study area and on only a few occasions as was done in 1985 and 1986.

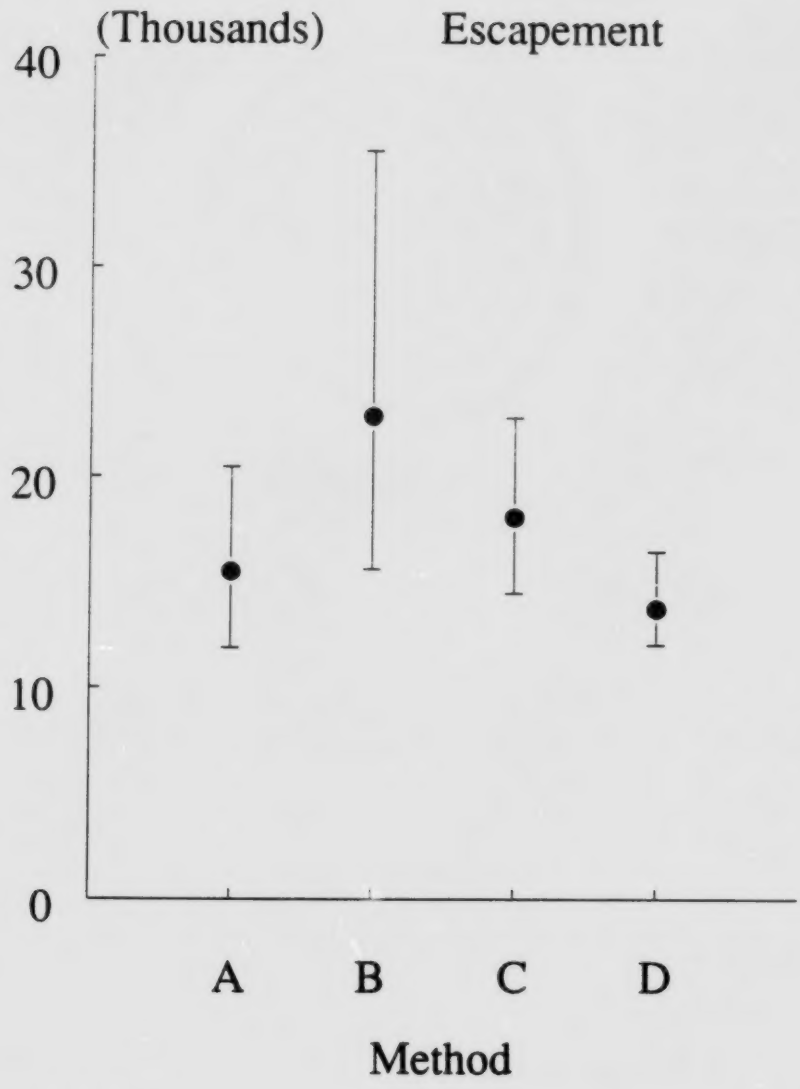

Figure 2. Escapement estimates and 95% confidence limits (Poisson distribution) for chinook salmon in the Campbell/Quinsam rivers system, 1988, using 4 different Petersen population estimators. Methods A-C are from live tagging with recoveries at Quinsam Hatchery (Method A), Campbell and Quinsam rivers (Method B) and Hatchery plus both rivers (Method C) (see Table 45). Method D is carcass tagging and recovery in both rivers plus actual Quinsam Hatchery rack recoveries (from Table 16).

Errors in the raw data (most notably in the number of carcasses examined, see Appendices) may have caused an over-or under-estimation of the escapements. For example, on some days, crews recorded that they observed fewer carcasses than the sum of the number of tags recovered and the number of tags applied. The sum of these two numbers should always be less than or equal to the total number of carcasses examined. This type of error, if significant, could lead to an underestimate of the total number of carcasses examined, and hence an underestimate of the population.

Recognition of tags was less than 100%. In 1988, spot checks for adipose marks that were overlooked during initial examination were implemented at Quinsam Hatchery. During a recheck of 364 chinook salmon broodstock, it was found that two ear tags had been missed as well as one secondary mark. The rate of missed opercular punches on chinook salmon in the Harrison River was approximately 10% (K. Wilson, Biologist, Department of Fisheries and Oceans, 555 W. Hastings Street, Vancouver, B.C., V6B 5G3, pers. comm. 1987) and approximately 10% of a known group of spaghetti tags in the Somass River were undetected (Shardlow et al. 1986). We were not able to test for this source of bias in the carcass recoveries of the present study, but in future studies, repitches of carcasses should be conducted to make adjustments for the proportion of missed tags.

A frequent source of bias in Petersen estimates of fish populations is tag loss (Ricker 1975). Operculum tagging with cattle ear tags appears to be particularly effective for chinook salmon, as indicated by the very low percent tag loss in the present study. This suggests that operculum tags should be used in future studies.

In future enumeration of the Campbell and Quinsam chinook salmon escapement, carcass tagging programs should be designed in a similar way to the 1987-88 study. Programs should include tag and recovery rates with equal effort in proportion to the number of spawners in each area, and Petersen or other type of estimates should be stratified by river and sex. Such procedures should result in estimates with reasonable levels of precision.

Of the three live tagging methods examined, only method C (all sources of recovery data) is valid because it is the only one which spreads recovery effort over the entire system. The live tagging escapement estimate using Method C was higher (18073) than the carcass tagging escapement estimate of 13750 although the 95% confidence limits did overlap substantially. We are unable to say which of these two estimates is more accurate although if substantial numbers of chinook migrated up the Quinsam River, above the Quinsam Hatchery, then the carcass tagging method would underestimate the escapement. On the other hand, by only tagging during a two week period and not over the entire run, the live tagging estimates could be biased.

AGE, LENGTH AND SEX COMPOSITION

The Campbell and Quinsam rivers chinook escapements are composed mainly of age 4 and 5 fish. The mean length of chinook in the Quinsam/Campbell river system has not changed significantly over the three years of this study. The ratio of males to females, as determined from the Petersen estimates, in the Campbell River changed from 0.87 in 1986 to 1.09 in 1988. Similarly, the ratio of males to females in the Quinsam River increased from 1.16 in 1986 to 1.55

in 1988. The sex ratio of hatchery returns fluctuated from 1.36 in 1986 to 1.95 in 1987, and back to 1.45 in 1988.

CODED WIRE TAGGING AND RECOVERY

In this study, we used the adipose clip rate in the dead recovery of chinook in the rivers and at the hatchery rack to estimate the number of adipose clips in the escapement. Sampling for adipose clipped fish was random at each of these locations. There was no significant difference in the mark rates of the three recovery areas in the Quinsam/Campbell system (sexes pooled, contingency $x^2=1.58$, df=5, $p>0.05$).

Although we have tried to address as many potential sources of bias as possible in the estimation of the escapement of CWTs described above, we have not explicitly included the following factors:

1) The low number of recoveries of adipose clips and decoded CWTs (less than 20 CWTs in some brood years) may make the precision of the estimates so low as to be of relatively little use in those brood years; and

2) The sample of heads obtained for the decoding of CWTs may not be a random sample from the population and might contain a bias due to size selectivity or other factors.

We have not formally estimated the level of precision of the estimates of escapement by adipose clipped fish and individual tag codes as potential sources of bias can render these misleading. An approximation of the level of precision can be obtained by examining the number of adipose clips/CWT recoveries on which a given estimate is based. There were 109 to 331 adipose clips enumerated for each sex (jacks and males pooled). The 95% confidence limits for 109 recoveries (based on a Poisson frequency distribution) would be approximately ± 20% and significantly smaller for 331 recoveries. These estimates of precision are conservative because the expansion factors used to estimate the total number of adipose clips/marks in the escapement are also estimated with error. In future programs, sampling of adipose clipped fish should not be selective in any way.

The hatchery contribution to the escapement in each of the Campbell River and the Quinsam river has increased significantly between 1986 and 1988 (sexes pooled, contingency $X^2=$ 13.09, df=5, $p<0.05$). There were also differences between the hatchery contribution to each of the Campbell river, the Quinsam River, and the Quinsam Hatchery within each year but these differences were not significant (sexes pooled, contingency $X^2=$ 10.14, df=5, $p>0.05$). In general, there was a higher proportion of hatchery reared fish in the Quinsam River and Hatchery than in the Campbell River.

SUMMARY

1. Total escapement estimates for chinook salmon in the Campbell/Quinsam rivers system using carcass tagging were 7298 in 1986, 8295 in 1987, and 13750 in 1988. These estimates were stratified by river and sex.

2. The age composition of chinook varied between the Campbell and Quinsam rivers and the Quinsam Hatchery as well as between years. Male chinook were predominantly age 4 or 5 while females were predominantly age 5. In 1987, there was a large proportion of age 3 males.

3. Males were generally more abundant than females.

4. The mean length of chinook salmon was greatest in the Campbell River, and smallest in the Quinsam Hatchery returns. Females were larger than males.

5. The total estimated return of adipose clipped chinook to the Campbell/Quinsam rivers system was 1902 in 1986, 1862 in 1987, and 1346 in 1988.

6. The total estimated hatchery contribution to the chinook escapement was 4350 in 1986 (59.6%) in 1986, 6249 (75.3%) in 1987, and 11828 (86.0%) in 1988.

6. The estimated chinook escapement in the Campbell/Quinsam rivers system in 1988 using live tagging was 18073. The 95% confidence limits on this estimate overlapped those for the carcass tagging Petersen estimate.

ACKNOWLEDGEMENTS

The authors sincerely thank Rick Semple, Sandy Argue, Brian Riddell, Jim Van Tine and Carol Cross for reviewing a draft of the manuscript. We also thank the Quinsam Hatchery field crews who collected data for this study. Lisa Clark helped prepare the final manuscript.

REFERENCES

Andrews, J.H., M. Lightly, and T.M. Webb. 1988. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1985. Can. Man. Rep. Fish. Aquat. Sci. 2007: 46 p.

Armstrong, R.W. and A.W. Argue. 1977. Trapping and coded wire tagging of wild coho and chinook juveniles from the Cowichan River system, 1975. Fish. Mar. Serv., Tech. Rep. Ser. PAC/T-77-14: 58 p.

Blackmun, G.J. B.V. Lukyn, W.E. McLean and D. Ewart. 1985. Quinsam watershed study: 1983. Can. MS Rep. Fish. Aquat. Sci. 1832: ix + 65 p.

Eames, M. and M. Hino. 1981. A mark-recapture study of an enumerated coho spawning population. Wash. Dep. Fish. Progr. Rep. 148: 22 p.

Eames, M., I. Quinn, K. Reidinger and D. Harling. 1981. Northern Puget Sound 1976 adult coho and chum tagging studies. Wash. Dep. Fish. Tech. Rep. 64: 217 p.

Gilbert, C.H. and W.H. Rich. 1927. Investigations concerning the red salmon runs to the Karluk River, Alaska. Bull. U.S. Bus. Fish. 43(2): 1-69 (Doc. No 991).

Hamilton, R. and J.W. Buell. 1976. The effects of modified hydrology on Campbell River salmonids. Environment Canada, Fish. Mar. Serv., Tech. Rep. Ser. PAC/T-76-20: 156 p. + appendices.

Jefferts, K.B., P.K. Bergman and H.F. Fiscus. 1963. A coded wire tag identification system for macro-organisms. Nature (London) 198: 460-462.

Johnson, J.K. and J.R. Longwill. 1988. Pacific salmonid coded wire tag releases through 1987. Regional Mark Processing Centre, Pac. Mar. Fish. Comm., Portland, Oregon. Unpubl. Rep.

Levings, C. 1986. Fish and invertebrate utilization of Campbell River estuary islands. p. 16-19 In: J. Patterson (ed.) Proceedings of the workshop on habitat improvements, Whistler, B.C., 8-10 May 1984. Can. Tech. Rep. Fish. Aquat. Sci. 1483.

Marshall, D.E., R.F. Brown, V.d. Chahley and D.G. Demontier. 1977. Preliminary catalogue of salmon streams and spawning escapements of Statistical Area 13 (Campbell River). Environment Canada. Fish. Mar. Serv. PAC/D-77-1: 176 p.

Petersen, A.E. 1954. The selective action of gillnets on Fraser River sockeye salmon. Int. Pac. Salmon Fish. Comm. Bull. 5: 101 p.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 p.

Shardlow, T.F., T. Webb and D.T. Lightly. 1986. Chinook salmon escapement estimation of the Campbell and Quinsam rivers in 1984: accuracy and precision of mark/recapture techniques using tagged salmon carcasses. Can. Tech. Rep. Fish. Aquat. Sci. 1507: 52 p.

Ward, F.J. 1959. Character of the migration of pink salmon to Fraser River spawning grounds in 1957. Int. Pac. Salmon Fish. Comm. Bull. 10: 70 p.

Wilson, K.H. and J.R. Andrew. 1987. The influence of gillnet hang ratio on the catch of salmon in the Fraser River. Can. Tech. Rep. Fish. Aquat. Sci. 1516: vii + 16 p.

Table 1. Summary of methods for the Campbell and Quinsam rivers chinook salmon enumeration programs, 1986-88.

Item	Method and Materials		
	1986	1987	1988
Dead recovery population estimate	Petersen estimate, sum of separate estimates for sexes and rivers	Petersen estimate, sum of separate estimates for sexes and rivers	Petersen estimate, sum of separate estimates for sexes and rivers
Live tagging population estimate	None	None	Petersen estimate, sum of separate estimates for sexes and rivers
Dead tagging	Cattle ear tags on used hatchery broodstock and then released Cattle ear tags applied in situ to carcasses recovered in river	Cattle ear tags applied in situ to carcasses recovered in river	Cattle ear tags applied in situ to carcasses recovered in river
Live Tagging	None	None	Cattle ear tags applied to live chinook captured in estuary
Secondary marking (dead)	None	two hole opercular punch for Campbell and three hole punch for Quinsam	two hole opercular punch for Campbell and single hole punch for Quinsam on left operculum
Secondary marking (live)	None	None	single hole opercular punch, right side
Recovery of fish	Foot, boat, SCUBA surveys, rack	Foot, boat, SCUBA surveys, rack	Foot, boat, SCUBA surveys, rack
Coded-wire tagging (CWT)	Collection of heads from adipose clipped fish in dead recovery and at hatchery rack	Collection of heads from adipose clipped fish in dead recovery and at hatchery rack	Collection of heads from adipose clipped fish in dead recovery and at hatchery rack
Biological and physical sampling	Ages from scales and CWT Sex ratios from sex specific population estimates for each river and at hatchery rack Postorbital-hypural length (mm)	Ages from scales and CWT Sex ratios from sex specific population estimates for each river and at hatchery rack Postorbital-hypural length (mm)	Ages from scales and CWT Sex ratios from sex specific population estimates for each river and at hatchery rack Postorbital-hypural length (mm)

Table 2. Summary of release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1986.

River	Date	Number released			
		Males	Females	Jacks	Total
Campbell (a)	Oct-19	28	19	3	50
	Oct-26	25	24	1	50
	Nov-03	22	20	8	50
	Nov-09	13	29	8	50
	Total	88	92	20	200
Quinsam (b)	Oct-20	20	21	9	50
	Oct-27	19	30	1	50
	Nov-03	22	20	8	50
	Nov-10	19	29	2	50
	Total	80	100	20	200

(a) See Appendix A1 for numbers by release site
(b) See Appendix A2 for numbers by release site

Table 3. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1986

River	Date	Number released			
		Males	Females	Jacks	Total
Campbell (a)	Oct-16	4	2	0	6
	Oct-20	8	7	0	15
	Oct-21	17	14	0	31
	Oct-22	8	11	0	19
	Oct-23	17	13	2	32
	Oct-24	18	13	1	32
	Oct-27	16	19	0	35
	Oct-28	8	20	0	28
	Oct-29	33	48	6	87
	Oct-30	21	47	5	73
	Oct-31	19	22	0	41
	Nov-01	16	24	1	41
	Nov-03	6	10	1	17
	Nov-04	11	28	1	40
	Nov-05	2	3	1	6
	Nov-06	8	16	1	25
	Nov-07	3	9	0	12
	Nov-10	3	7	1	11
	Nov-11	3	12	0	15
	Nov-12	1	6	0	7
	Nov-13	1	7	0	8
	Nov-14	2	8	0	10
	Nov-17	0	2	0	2
	Nov-18	1	1	0	2
	Total	226	349	20	595
Quinsam (b)	Oct-17	5	11	0	16
	Oct-21	3	5	3	11
	Oct-22	3	3	0	6
	Oct-23	1	3	1	5
	Oct-24	0	1	0	1
	Oct-28	6	8	0	14
	Oct-29	4	7	0	11
	Oct-30	1	4	1	6
	Nov-04	4	2	0	6
	Nov-05	6	13	2	21
	Nov-06	0	5	0	5
	Nov-07	2	5	1	8
	Nov-11	2	14	0	16
	Nov-12	3	9	0	12
	Nov-13	1	2	0	3
	Nov-14	1	5	0	6
	Nov-17	0	4	0	4
	Nov-19	0	1	0	1
	Total	42	102	8	152

(a) See Appendix B1 for daily summaries for each release area
(b) See Appendix B2 for daily summaries for each release area

Table 4. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1987.

River	Date	Number released			
		Males	Females	Jacks	Total
Campbell (a)	Oct-19	6	1	0	7
	Oct-21	2	0	0	2
	Oct-22	1	4	1	6
	Oct-23	8	5	0	13
	Oct-26	5	1	1	7
	Oct-27	14	15	2	31
	Oct-28	6	3	0	9
	Oct-29	7	11	1	19
	Oct-30	10	7	0	17
	Nov-02	9	11	0	20
	Nov-03	22	31	2	55
	Nov-04	41	35	3	79
	Nov-05	9	16	1	26
	Nov-06	15	20	0	35
	Nov-07	9	12	4	25
	Nov-09	4	20	0	24
	Nov-10	14	25	1	40
	Nov-12	8	23	1	32
	Nov-13	12	25	3	40
	Nov-17	5	22	2	29
	Nov-19	3	5	0	8
	Total	210	292	22	524
Quinsam (b)	Oct-19	0	0	1	1
	Oct-21	0	1	0	1
	Oct-26	0	11	1	12
	Oct-29	3	10	0	13
	Nov-02	4	15	5	24
	Nov-03	4	19	6	29
	Nov-05	10	30	12	52
	Nov-06	2	7	1	10
	Nov-09	17	43	28	88
	Nov-11	11	21	15	47
	Nov-12	1	6	0	7
	Nov-16	18	22	17	57
	Nov-19	11	26	4	41
	Nov-20	3	8	3	14
	Nov-23	3	9	1	13
	Total	87	228	94	409

(a) See Appendix C1 for daily summaries for each release area

(b) See Appendix C2 for daily summaries for each release area

Table 5. Summary of in situ release of tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1988.

River	Date	Number released			
		Males	Females	Jacks	Total
Campbell (a)	Oct-17	0	2	1	3
	Oct-18	7	4	0	11
	Oct-20	4	4	1	9
	Oct-21	3	3	1	7
	Oct-25	28	27	3	58
	Oct-26	5	5	1	11
	Oct-27	2	7	0	9
	Oct-28	20	12	3	35
	Oct-31	14	9	2	25
	Nov-01	14	30	2	46
	Nov-02	1	4	0	5
	Nov-04	25	56	2	83
	Nov-08	13	24	0	37
	Nov-09	8	14	1	23
	Nov-10	8	11	2	21
	Nov-15	10	23	1	34
	Nov-16	7	6	2	15
	Nov-18	3	5	0	8
	Nov-21	5	3	0	8
	Nov-23	1	1	0	2
	Total	178	250	22	450
Quinsam (a)	Oct-17	10	9	1	20
	Oct-19	9	6	2	17
	Oct-24	36	18	12	66
	Oct-26	16	5	7	28
	Oct-27	7	28	3	38
	Oct-31	35	37	8	80
	Nov-01	23	32	14	69
	Nov-02	1	1	0	2
	Nov-03	16	10	7	33
	Nov-07	4	12	4	20
	Nov-11	16	28	2	46
	Nov-14	36	70	2	108
	Nov-15	14	31	0	45
	Nov-17	47	81	2	130
	Nov-18	33	42	2	77
	Nov-22	17	21	0	38
	Nov-24	22	30	1	53
	Nov-25	4	3	0	7
	Nov-26	10	4	0	14
	Nov-30	24	33	1	58
	Dec-01	4	5	0	9
	Dec-02	5	5	0	10
	Dec-05	0	4	2	6
	Total	389	515	70	974

(a) See Appendix D1 for daily summaries for each release area
(b) See Appendix D2 for daily summaries for each release area

Table 6. Summary of recovery effort (number of days) for chinook salmon carcasses in Campbell and Quinsam rivers, 1986.

River	Area (a)	Number of days
Campbell	1A	22
	1B	26
	Mean	24
Quinsam	2B	12
	2C	14
	2D	12
	Mean	13

(a) See Fig. 1 for location of recovery areas

Table 7. Summary of recovery effort (number of days) for chinook salmon carcasses in Campbell and Quinsam rivers, 1987.

River	Area (a)	Number of days
Campbell	1A	19
	1B	23
	Mean	21
Quinsam	2B	12
	2C	15
	2D	16
	Mean	14

(a) See Fig. 1 for location of recovery areas

Table 8. Summary of recovery effort (number of days) for chinook salmon carcasses in Campbell and Quinsam rivers, 1988.

River	Area (a)	Number of days
Campbell	1A	21
	1B	24
	Mean	23
Quinsam	2B	18
	2C	22
	2D	17
	Mean	19

(a) See Fig. 1 for location of recovery areas

Table 9. Summary of tagging and release of used hatchery chinook broodstock carcasses and dead recovery in Campbell and Quinsam river, 1986.

Category	Campbell (a)	Quinsam (b)	Total
Carcass tagging:			
Males	88	80	168
Females	92	100	192
Jacks	20	20	40
Total	200	200	400
Dead recovery:			
Males	985	314	1299
Females	1332	339	1671
Jacks	47	42	89
Total	2364	695	3059
Tagged males (c)	32	57	89
Tagged females	58	75	133
Tagged jacks	8	12	20
Total tagged	98	144	242
Tag rate (%)	4.2	20.7	7.9
Tag recovery rate (%)	49.0	72.0	60.5
tag loss (%)	-	-	-

(a) See Table 2 and Appendix A5 for raw data regarding carcass tagging and Appendix A5 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(b) See Table 2 and Appendix A6 for raw data regarding carcass tagging and Appendix A6 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(c) Tagged recoveries include all hole punched carcasses (i.e. secondary marks)

Table 10. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam rivers, 1986.

Category	Campbell (a)	Quinsam (b)	Total
Carcass tagging:			
Males	226	42	268
Females	349	102	451
Jacks	20	8	28
Total	595	152	747
Dead recovery:			
Males	985	314	1299
Females	1332	339	1671
Jacks	39	39	78
Total	2356	692	3048
Tagged males (c)	121	22	143
Tagged females	209	59	268
Tagged jacks	8	3	11
Total tagged	338	84	422
Tag rate (%)	14.4	12.1	13.8
Tag recovery rate (%)	56.8	55.3	56.5
Tag loss (%)	-	-	-

(a) See Table 3 and Appendix B5 for raw data regarding carcass tagging and Appendix B5 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(b) See Table 3 and Appendix B6 for raw data regarding carcass tagging and Appendix B6 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(c) Tagged recoveries include all hole punched carcasses (i.e. secondary marks)

Table 11. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam rivers, 1987.

Category	Campbell (a)	Quinsam (b)	Total
Carcass tagging:			
Males	210	87	297
Females	292	228	520
Jacks	22	94	116
Total	524	409	933
Dead recovery:			
Males	589	235	824
Females	793	584	1377
Jacks	64	338	402
Total	1446	1157	2603
Tagged males (c)	102	47	149
Tagged females	183	147	330
Tagged jacks	5	36	41
Total tagged	290	230	520
Tag rate (%)	20.1	19.9	20.0
Tag recovery rate (%)	55.3	56.2	55.7
Tag loss (%)	1.7	2.6	2.2

(a) See Table 4 and Appendix C5 for raw data regarding carcass tagging and Appendix C5 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(b) See Table 4 and Appendix C6 for raw data regarding carcass tagging and Appendix C6 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(c) Tagged recoveries include all hole punched carcasses (i.e. secondary marks)

Table 12. Summary of in situ carcass tagging and dead recovery of chinook salmon in Campbell and Quinsam rivers, 1988.

Category	Campbell (a)	Quinsam (b)	Total
Carcass tagging:			
Males	178	389	567
Females	250	515	765
Jacks	22	70	92
Total	450	974	1424
Dead recovery:			
Males	481	1035	1516
Females	548	1083	1631
Jacks	77	198	275
Total	1106	2316	3422
Tagged males (c)	77	174	251
Tagged females	102	250	352
Tagged jacks	4	12	16
Total tagged	183	436	619
Tag rate (%)	16.5	18.8	18.1
Tag recovery rate (%)	40.7	44.8	43.5
Tag loss (%)	0.5	1.8	1.2

(a) See Table 5 and Appendix D5 for raw data regarding carcass tagging and Appendix D5 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(b) See Table 5 and Appendix D6 for raw data regarding carcass tagging and Appendix D6 for tagged recoveries and for total dead recoveries (i.e. numbers examined for the presence of tags)

(c) Tagged recoveries include all hole punched carcasses (i.e. secondary marks)

Table 13. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on hatchery broodstock carcass release and recovery of carcasses, 1986. Confidence limits are from fiducial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343). The number of hatchery carcasses released is subtracted from the population estimates for Campbell and Quinsam rivers.

River and item	Male	Female	Jack	Total
Campbell River				
Number tagged	88	92	20	200
Number recovered	985	1332	47	2364
Number of tagged fish recovered	32	58	8	98
Number of tagged strays from Quinsam River	1	0	0	1
Expanded No. of tagged strays from Quinsam River	3	0	0	3
Number of tagged fish for Petersen estimate	91	92	20	203
Petersen estimate	2661	2009	92	4762
Upper 95% CL	3746	2611	209	6566
Lower 95% CL	1876	1540	40	3456
Quinsum River				
Number tagged	80	100	20	200
Number recovered	314	339	42	695
Number of tagged fish recovered	57	75	12	144
Number of tagged strays from Campbell River	0	0	0	0
Expanded No. of tagged strays from Campbell River	0	0	0	0
Number of tagged fish for Petersen estimate	77	100	20	197
Petersen estimate	344	352	49	745
Upper 95% CL	466	464	105	1036
Lower 95% CL	248	261	21	531
Quinsam Hatchery				
Rack recovery (a)	1070	799	16	1885
Total system escapement	4075	3160	157	7392
Upper 95% CL	5282	3874	330	9486
Lower 95% CL	3194	2600	77	5871

(a) Confidence limits not applicable

Table 14. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1986. Confidence limits are from fiducial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343).

River and item	Male	Female	Jack	Total
Campbell River				
Number tagged	226	349	20	595
Number recovered	985	1332	39	2356
Number of tagged fish recovered	121	209	8	338
Number of tagged strays from Quinsam River	0	0	0	0
Expanded No. of tagged strays from Quinsam River	0	0	0	0
Number of tagged fish for Petersen estimate	226	349	20	595
Petersen estimate	1835	2222	93	4150
Upper 95% CL	2189	2542	191	4922
Lower 95% CL	1538	1941	50	3529
Quinsum River				
Number tagged	42	102	8	152
Number recovered	314	339	39	692
Number of tagged fish recovered	22	59	3	84
Number of tagged strays from Campbell River	0	0	0	0
Expanded No. of tagged strays from Campbell River	0	0	0	0
Number of tagged fish for Petersen estimate	42	102	8	152
Petersen estimate	589	584	90	1263
Upper 95% CL	873	749	225	1847
Lower 95% CL	395	454	37	886
Quinsam Hatchery				
Rack recovery (a)	1070	799	16	1885
Total system escapement	3494	3605	199	7298
Upper 95% CL	4132	4090	432	8654
Lower 95% CL	3003	3194	103	6300

(a) Confidence limits not applicable

Table 15. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1987. Confidence limits are from fiducial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343).

River and item	Male	Female	Jack	Total
Campbell River				
Number tagged	210	292	22	524
Number recovered	589	793	64	1446
Number of tagged fish recovered	102	183	5	290
Number of tagged strays from Quinsam River	0	3	0	3
Expanded No. of tagged strays from Quinsam River	0	5	0	5
Number of tagged fish for Petersen estimate	210	297	22	529
Petersen estimate	1209	1286	249	2744
Upper 95% CL	1464	1485	575	3524
Lower 95% CL	997	1113	118	2229
Quinsum River				
Number tagged	87	228	94	409
Number recovered	235	584	338	1157
Number of tagged fish recovered	47	147	36	230
Number of tagged strays from Campbell River	0	0	0	0
Expanded No. of tagged strays from Campbell River	0	0	0	0
Number of tagged fish for Petersen estimate	87	223	94	404
Petersen estimate	433	885	870	2188
Upper 95% CL	585	1039	1234	2858
Lower 95% CL	327	754	634	1715
Quinsam Hatchery				
Rack recovery (a)	1116	1139	1108	3363
Total system escapement	2757	3310	2228	8295
Upper 95% CL	3165	3663	2917	9745
Lower 95% CL	2440	3006	1860	7306

(a) Confidence limits not applicable

Table 16. Petersen population estimates, confidence limits and enumeration data for chinook salmon escapement in the Campbell/Quinsam river system (Campbell River, Quinsam River, Quinsam Hatchery rack) based on in situ chinook carcass tagging and recovery of carcasses, 1988. Confidence limits are from fiducial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343).

River and item	Male	Female	Jack	Total
Campbell River				
Number tagged	178	250	22	450
Number recovered	481	548	77	1106
Number of tagged fish recovered	77	102	4	183
Number of tagged strays from Quinsam River	6	13	1	20
Expanded No. of tagged strays from Quinsam River	14	32	6	52
Number of tagged fish for Petersen estimate	192	282	28	502
Petersen estimate	1193	1508	452	3153
Upper 95% CL	1486	1827	1131	4444
Lower 95% CL	957	1245	202	2404
Quinsum River				
Number tagged	389	515	70	974
Number recovered	1035	1083	198	2316
Number of tagged fish recovered	174	250	12	436
Number of tagged strays from Campbell River	0	0	0	0
Expanded No. of tagged strays from Campbell River	0	0	0	0
Number of tagged fish for Petersen estimate	375	483	64	922
Petersen estimate	2226	2090	995	5311
Upper 95% CL	2580	2365	1797	6741
Lower 95% CL	1920	1848	588	4356
Quinsam Hatchery				
Rack recovery (a)	2455	2160	671	5286
Total system escapement	5874	5758	2118	13750
Upper 95% CL	6521	6352	3599	16471
Lower 95% CL	5332	5253	1461	12046

(a) Confidence limits not applicable

Table 17. Age composition of Campbell River chinook salmon, 1986 (Determined from dead recovery).

Sex and age	Unmarked	Adipose Clipped	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
						N	Mean	SE	95% CL	
									Lower	Upper
Males (a)										
2.1	0	0	1	1	0.2	1	435	0	435	435
3.1	22	0	3	25	5.3	25	578	35	506	650
4.1	59	0	69	128	26.9	128	745	53	639	851
5.1	147	1	171	319	67.0	320	846	53	742	950
5.2	2	0	0	2	0.4					
6.1	1	0	0	1	0.2	1	910	0	910	910
Total aged	231	1	244	476	100.0	475	804 (b)	38	699	840
Unknown age				49		49	808	93	622	994
Total				525						
Females										
4.1	32	0	30	62	10.0	62	763	46	671	855
5.1	293	3	257	553	89.3	553	845	44	759	931
6.1	3	0	1	4	0.7	4	876	40	749	1003
Total aged	328	3	288	619	100.0	619	837 (b)	40	726	930
Unknown age				47		65	831	46	739	923
Total				666						

(a) Includes jacks
(b) Weighted mean and standard error

Table 18. Age composition of Quinsam River chinook salmon, 1986 (Determined from dead recovery).

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
2.1	1	1	2	1.4	2	480	148	0	2360
3.1	7	4	11	7.7	11	570	33	496	644
4.1	27	66	93	65.5	93	717	64	589	845
5.1	12	24	36	25.4	35	802	46	710	894
Total aged	47	95	142	100.0	141	723 (b)	44	449	1186
Unknown age			18		18	723	94	525	921
Total			160						
Females									
4.1	24	31	55	27.4	55	742	56	630	854
5.1	70	75	145	72.1	145	815	43	731	899
6.1	1	0	1	0.5	1	760	0	760	760
Total aged	95	106	201	100.0	200	795 (b)	35	707	838
Unknown age			28		28	763	66	628	898
Total			229						

(a) Includes jacks
(b) Weighted mean and standard error

Table 19. Age composition of Quinsam Hatchery chinook salmon, 1986. (Determined from rack recovery)

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
2.1	43	5	48	7.8	48	376	43	290	462
3.1	146	27	173	28.0	173	590	57	476	704
4.1	185	159	344	55.8	344	712	59	596	828
5.1	19	33	52	8.4	52	797	74	649	945
Total aged	393	224	617	100.0	617	659 (b)	37	503	735
Unknown age			64		64	655	142	371	939
Total			681						
Females									
3.1	7	0	7	1.3	7	663	25	602	724
4.1	196	128	324	60.6	324	743	46	653	833
5.1	68	132	200	37.4	199	817	46	727	907
6.1	2	2	4	0.7	4	850	66	640	1060
Total	273	262	535	100.0	534	770 (b)	33	655	881
Unknown age			42		42	777	70	636	918
Total			577						

(a) Includes jacks
(b) Weighted mean and standard error

Table 20. Age composition of Campbell River chinook salmon, 1987. (Determined from dead recovery)

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
3.1	10	12	22	9.5	22	574	54	461	687
4.1	39	29	68	29.3	67	785	58	669	901
5.1	38	79	117	50.4	116	859	58	745	973
6.1	6	19	25	10.8	24	878	65	744	1012
Total aged	93	139	232	100.0	229	812 (b)	35	655	893
Unknown age			69		69	814	128	558	1070
Total			301						
Females									
4.1	40	9	49	13.6	48	793	33	727	859
5.1	91	114	205	56.6	203	844	46	754	934
6.1	42	62	104	28.7	105	881	51	779	983
6.2	4	0	4	1.1					
Total aged	177	185	362	100.0	356	848 (b)	45	753	925
Unknown age			72		72	851	52	747	955
Total			434						

(a) Includes jacks
(b) Weighted mean and standard error

Table 21. Age composition of Quinsam River chinook salmon, 1987. (Determined from dead recovery)

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
3.1	60	37	97	43.7	96	583	52	479	687
4.1	51	16	67	30.2	67	742	56	630	854
5.1	14	38	52	23.4	52	791	73	6[illegible]	937
6.1	2	3	5	2.3	6	838	65	671	1005
6.2	1	0	1	0.4					
Total aged	128	94	222	100.0	221	687 (b)	33	606	871
Unknown age			79		79	706	112	482	930
Total			301						
Females									
3.1	2	1	3	0.9	3	685	39	517	853
4.1	75	13	88	24.5	88	769	43	683	855
5.1	102	125	227	63.2	227	821	48	727	915
6.1	17	24	41	11.4	41	848	50	748	948
Total aged	196	163	359	100.0	359	810 (b)	33	669	893
Unknown age			63		63	816	52	712	920
Total			422						

(a) Includes jacks
(b) Weighted mean and standard error

Table 22. Age composition of Quinsam Hatchery chinook salmon, 1987. (Determined from rack recovery)

Sex and age	Unmarked	Adipose clipped	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
						N	Mean	SE	95% CL	
									Lower	Upper
Males (a)										
2.1	3	0	0	3	0.7	3	379	51	160	598
3.1	56	0	99	155	37.2	154	579	59	457	701
4.1	54	0	44	98	23.5	98	747	66	615	879
5.1	29	0	123	152	36.4	153	811	49	715	907
6.1	2	0	7	9	2.2	8	818	69	655	981
Total aged	144	0	273	417	100.0	416	707 (b)	32	611	867
Unknown age				96		96	678	127	424	932
Total				513						
Females										
3.1	1	0	1	2	0.4	2	623	11	483	763
4.1	34	0	22	56	12.6	56	771	51	669	873
5.1	87	3	260	350	78.7	350	832	45	744	920
6.1	2	0	35	37	8.3	37	860	48	764	956
Total aged	124	3	318	445	100.0	445	826 (b)	36	665	878
Unknown age				38		38	824	69	686	962
Total				483						

(a) Includes jacks
(b) Weighted mean and standard error

Table 23. Age composition of Campbell River chinook salmon, 1988 (Determined from dead recovery).

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
3.1	3	2	5	3.1	4	535	33	430	640
4.1	80	27	107	65.2	106	761	75	611	911
5.1	28	22	50	30.5	49	890	58	774	1006
6.1	0	2	2	1.2	2	948	11	808	1088
Total aged	111	53	164	100.0	161	797 (b)	52	656	911
Unknown age			17		17	782	105	559	1005
Total			181						
Females									
4.1	48	26	74	33.0	73	768	50	668	868
5.1	103	25	128	57.1	126	860	54	752	968
6.1	8	13	21	9.5	20	895	56	777	1013
7.1	0	1	1	0.4	1	895	0	895	895
Total aged	159	65	224	100.0	220	833 (b)	35	773	936
Unknown age			29		29	855	50	752	958
Total			253						

(a) Includes jacks
(b)Weighted mean and standard error

Table 24. Age composition of Quinsam River chinook salmon, 1988 (Determined from dead recovery).

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm)				
					N	Mean	SE	95% CL	
								Lower	Upper
Males (a)									
3.1	2	3	5	2.2	5	584	23	520	648
4.1	116	73	189	84.0	189	743	67	612	874
5.1	13	15	28	12.5	28	870	75	716	1024
7.1	0	3	3	1.3	3	835	48	629	1041
Total aged	131	94	225	100.0	225	744 (b)	57	619	897
Unknown age			166		166	723	100	527	919
Total									
Females									
4.1	88	66	154	58.6	154	760	53	656	864
5.1	56	33	89	33.8	89	859	51	757	961
6.1	2	17	19	7.2	18	851	45	757	946
7.1	1	0	1	0.4	1	870	0	870	870
Total aged	147	116	263	100.0	262	800 (b)	36	760	910
Unknown age			175		175	778	69	643	913
Total			692						

(a) Includes jacks
(b) Weighted mean and standard error

Table 25. Age composition of Quinsam Hatchery chinook salmon, 1988 (Determined from rack recovery).

Sex and age	Unmarked	Ad/CWT	Total	Percent	Postorbital-hypural length (mm) N	Mean	SE	95% CL Lower	Upper
Males (a)									
2.1	0	8	8	1.9	8	397	50	279	515
3.1	12	15	27	6.4	26	600	46	503	697
4.1	174	190	364	86.0	362	731	60	613	849
5.1	6	16	22	5.2	22	855	58	734	976
6.1	0	2	2	0.5	2	807	60	44	1570
Total aged	192	231	423	100.0	420	723 (b)	52	474	1023
Unknown age			212		212	734	61	614	854
Total			635						
Females									
4.1	150	125	275	74.1	275	746	46	656	836
5.1	40	34	74	20.0	73	829	41	747	911
6.1	1	21	22	5.9	22	836	52	728	944
Total aged	191	180	371	100.0	370	768 (b)	35	710	897
Unknown age			189		189	769	56	659	879
Total			560						

(a) Includes jacks
(b) Weighted mean and standard error

Table 26. Petersen estimates, by age, of chinook salmon escapement to the Campbell River , Quinsam River, and Quinsam Hatchery, 1986. Petersen estimate is from in situ carcass tagging method.

River	Age	Males (a)		Females	
		Number	Percent	Number	Percent
Campbell River					
	2.1	4	0.2	0	0.0
	3.1	101	5.3	0	0.0
	4.1	518	26.9	222	10.0
	5.1	1293	67.0	1984	89.3
	5.2	8	0.4	16	0.7
	6.1	4	0.2	0	0.0
	Total	1928	100.0	2222	100.0
Quinsam River					
	2.1	10	1.4	0	0.0
	3.1	53	7.7	0	0.0
	4.1	444	65.5	160	27.4
	5.1	172	25.4	421	72.1
	5.2	0	0.0	3	0.5
	6.1	0	0.0	0	0.0
	Total	679	100.0	584	100.0
Quinsam Hatchery					
	2.1	84	7.8	0	0.0
	3.1	305	28.0	10	1.3
	4.1	605	55.8	484	60.6
	5.1	92	8.4	299	37.4
	6.1	0	0.0	6	0.7
	Total	1086	100.0	799	100.0

(a) Includes jacks

Table 27. Petersen estimates, by age, of chinook salmon escapement to the Campbell River , Quinsam River, and Quinsam Hatchery, 1987.

River	Age	Males (a)		Females	
		Number	Percent	Number	Percent
Campbell River					
	2.1	0	0.0	0	0.0
	3.1	138	9.5	0	0.0
	4.1	427	29.3	175	13.6
	5.1	736	50.4	728	56.6
	6.1	157	10.8	369	28.7
	6.2	0	0.0	14	1.1
	Total	1458	100.0	1286	100.0
Quinsam River					
	2.1	0	0.0	0	0.0
	3.1	569	43.7	8	0.9
	4.1	394	30.2	216	24.5
	5.1	305	23.4	560	63.2
	5.2	0	0	0	0.0
	6.1	30	2.3	101	11.4
	6.2	5	0.4	0	0.0
	Total	1303	100.0	885	100.0
Quinsam Hatchery					
	2.1	16	0.7	0	0.0
	3.1	827	37.2	5	0.4
	4.1	523	23.5	143	12.6
	5.1	810	36.4	896	78.7
	6.1	48	2.2	95	8.3
	Total	2224	100.0	1139	100.0

(a) Includes jacks

Table 28. Petersen estimates, by age, of chinook salmon escapement to the Campbell River , Quinsam River, and Quinsam Hatchery, 1988.

River	Age	Males (a)		Females	
		Number	Percent	Number	Percent
Campbell River					
	2.1	0	0.0	0	0.0
	3.1	51	3.1	0	0.0
	4.1	1072	65.2	498	33.0
	5.1	502	30.5	861	57.1
	6.1	20	1.2	143	9.5
	7.1	0	0.0	6	0.4
	Total	1645	100.0	1508	100.0
Quinsam River					
	2.1	0	0.0	0	0.0
	3.1	71	2.2	0	0.0
	4.1	2705	84.0	1226	58.6
	5.1	403	12.5	706	33.8
	6.1	0	0.0	150	7.2
	7.1	42	1.3	8	0.4
	Total	3221	100.0	2090	100.0
Quinsam Hatchery					
	2.1	59	1.9	0	0.0
	3.1	200	6.4	0	0.0
	4.1	2688	86.0	1601	74.1
	5.1	163	5.2	432	20.0
	6.1	16	0.5	127	5.9
	Total	3126	100.0	2160	100.0

(a) Includes jacks

Table 29. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1986.

River	Length class (mm)	Age													
		Males (a)							Females						
		2	3	4	5	6	Total	Unk(b)	2	3	4	5	6	Total	Unk
Campbell River															
	450-499	1	0	0	0	0	1	0	0	0	0	0	0	0	0
	500-549	0	2	0	0	0	2	0	0	0	0	0	0	0	0
	550-599	0	10	1	0	0	11	2	0	0	0	0	0	0	0
	600-649	0	11	1	0	0	12	2	0	0	0	0	0	0	0
	650-699	0	2	10	1	0	13	1	0	0	2	0	0	2	0
	700-749	0	0	33	5	0	38	3	0	0	9	3	0	12	0
	750-799	0	0	42	20	0	62	3	0	0	26	22	0	48	6
	800-849	0	0	35	81	0	116	15	0	0	22	165	0	187	24
	850-899	0	0	5	111	0	116	12	0	0	2	213	2	217	24
	900-949	0	0	1	88	1	90	9	0	0	1	138	2	141	9
	950-999	0	0	0	12	0	12	2	0	0	0	10	0	10	2
	1000-1049	0	0	0	2	0	2	0	0	0	0	2	0	2	0
	Mean	435	578	745	846	910	804(c)	808	0	0	763	845	876	837(c)	831
	SE	0	35	53	53	0	38	93	0	0	46	44	40	40	46
	N	1	25	128	320	1	475	49	0	0	62	553	4	619	65
Quinsam River															
	400-449	1	0	0	0	0	1	0	0	0	0	0	0	0	0
	450-499	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	500-549	0	1	0	0	0	1	0	0	0	0	0	0	0	0
	550-599	0	6	2	0	0	8	0	0	0	1	0	0	1	0
	600-649	1	3	6	0	0	10	2	0	0	1	0	0	1	1
	650-699	0	1	14	0	0	15	0	0	0	3	1	0	4	2
	700-749	0	0	30	3	0	33	3	0	0	12	4	0	16	7
	750-799	0	0	23	5	0	28	5	0	0	22	13	1	36	3
	800-849	0	0	15	18	0	33	7	0	0	15	68	0	83	10
	850-899	0	0	3	6	0	9	0	0	0	1	48	0	49	5
	900-949	0	0	0	3	0	3	0	0	0	0	9	0	9	0
	950-999	0	0	0	0	0	0	0	0	0	0	2	0	2	0
	Mean	480	570	717	802	0	723(c)	723	0	0	742	815	760	795(c)	763
	SE	148	33	64	46	0	44	94	0	0	56	43	0	35	66
	N	2	11	93	35	0	141	18	0	0	55	145	1	201	28

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 29. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1986. (cont.).

River	Length class (mm)	Age													
		Males (a)							Females						
		2	3	4	5	6	Total	Unk(b)	2	3	4	5	6	Total	Unk
Quinsam Hatchery															
	250-299	1	0	0	0	0	1	0	0	0	0	0	0	0	0
	300-349	4	0	0	0	0	4	0	0	0	0	0	0	0	0
	350-399	18	1	0	0	0	19	4	0	0	0	0	0	0	0
	400-449	19	2	0	0	0	21	6	0	0	0	0	0	0	0
	450-499	5	3	0	1	0	9	1	0	0	0	0	0	0	0
	500-549	1	9	0	0	0	10	1	0	0	1	0	0	1	0
	550-599	0	43	3	0	0	46	4	0	0	0	0	0	0	0
	600-649	0	70	22	0	0	92	4	0	0	3	1	0	4	1
	650-699	0	37	60	1	0	98	7	0	4	20	0	0	24	2
	700-749	0	7	118	6	0	131	14	0	3	83	4	0	90	6
	750-799	0	1	91	5	0	97	13	0	0	137	25	0	162	10
	800-849	0	0	47	22	0	69	6	0	0	70	79	2	151	15
	850-899	0	0	2	11	0	13	4	0	0	10	76	1	87	5
	900-949	0	0	1	5	0	6	0	0	0	0	13	0	13	3
	950-999	0	0	0	1	0	1	0	0	0	0	1	1	2	0
	Mean	376	590	712	797	0	659(c)	655	0	663	743	817	850	770(c)	777
	SE	43	57	59	74	0	37	142	0	25	46	46	66	33	70
	N	48	173	344	52	0	617	64	0	7	324	199	4	534	42

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 30. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1987.

River	Length class (mm)	Age													
		Males (a)							Females						
		2	3	4	5	6	Total	Unk(b)	2	3	4	5	6	Total	Unk
Campbell River															
	250-299	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	300-349	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	350-399	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	400-449	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	450-499	0	1	0	0	0	1	0	0	0	0	0	0	0	0
	500-549	0	5	0	1	0	6	1	0	0	0	0	0	0	0
	550-599	0	6	0	0	0	6	0	0	0	0	0	0	0	0
	600-649	0	7	1	0	0	8	1	0	0	0	0	0	0	0
	650-699	0	3	1	0	0	4	2	0	0	0	0	0	0	0
	700-749	0	0	8	0	0	8	2	0	0	1	3	1	5	1
	750-799	0	0	18	3	1	22	7	0	0	15	13	0	28	5
	800-849	0	0	25	24	4	53	19	0	0	25	57	16	98	14
	850-899	0	0	11	43	6	60	17	0	0	7	74	26	107	32
	900-949	0	0	2	33	7	42	12	0	0	0	49	44	93	13
	950-999	0	0	1	9	5	15	7	0	0	0	7	15	22	6
	1000-1049	0	0	0	3	1	4	0	0	0	0	0	3	3	1
	Mean	0	574	785	859	878	812(c)	814	0	0	793	844	881	848(c)	851
	SE	0	54	58	58	65	35	128	0	0	33	46	51	31	52
	N	0	22	67	116	24	229	69	0	0	48	203	105	356	72
Quinsam River															
	450-499	0	1	0	1	0	2	0	0	0	0	0	0	0	0
	500-549	0	13	0	0	0	13	4	0	0	0	0	0	0	0
	550-599	0	27	0	0	0	27	8	0	0	0	0	0	0	0
	600-649	0	37	2	0	0	39	12	0	0	0	0	0	0	0
	650-699	0	14	6	1	0	21	9	0	1	0	2	0	3	0
	700-749	0	3	14	7	0	24	10	0	2	16	6	0	24	3
	750-799	0	1	23	4	1	29	12	0	0	28	17	4	49	9
	800-849	0	0	20	21	2	43	13	0	0	38	99	9	146	25
	850-899	0	0	2	16	1	19	4	0	0	6	74	12	92	17
	900-949	0	0	0	2	2	4	6	0	0	0	28	15	43	9
	950-999	0	0	0	0	0	0	1	0	0	0	1	1	2	0
	Mean	0	583	742	791	838	687(c)	706	0	685	769	821	848	810(c)	816
	SE	0	52	56	73	65	33	112	0	39	43	48	50	33	52
	N	0	96	67	52	6	221	79	0	3	88	227	41	359	63

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 30. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1987. (cont.).

River	Length class (mm)	Age													
		Males (a)							Females						
		2	3	4	5	6	Total	Unk(b)	2	3	4	5	6	Total	Unk
Quinsam Hatchery															
	350-399	2	0	0	0	0	2	1	0	0	0	0	0	0	0
	400-449	0	0	1	0	0	1	2	0	0	0	0	0	0	0
	450-499	1	5	0	0	0	6	2	0	0	0	0	0	0	0
	500-549	0	23	0	0	0	23	5	0	0	0	0	0	0	0
	550-599	0	44	0	0	0	44	10	0	0	1	0	0	1	0
	600-649	0	54	2	0	0	56	17	0	1	0	0	0	1	0
	650-699	0	19	5	1	0	25	12	0	1	1	1	0	3	2
	700-749	0	7	25	7	2	41	8	0	0	8	4	0	12	2
	750-799	0	1	31	27	0	59	10	0	0	14	32	1	47	2
	800-849	0	1	23	58	1	83	21	0	0	25	117	9	151	13
	850-899	0	0	10	50	3	63	4	0	0	6	135	11	152	14
	900-949	0	0	1	8	2	11	2	0	0	1	58	13	72	2
	950-999	0	0	0	1	0	1	2	0	0	0	3	3	6	3
	1000-1049	0	0	0	1	0	1	0	0	0	0	0	0	0	0
	Mean	379	579	747	811	818	707(c)	678	0	623	771	832	860	826(c)	824
	SE	51	59	66	49	69	32	127	0	11	51	45	48	36	69
	N	3	154	98	153	8	416	96	0	2	56	350	37	445	38

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 31. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1988.

River	Length class (mm)	Age														
		Males (a)								Females						
		2	3	4	5	6	7	Total	Unk(b)	2	3	4	5	6	7	Total
Campbell River																
	500-549	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0
	550-599	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0
	600-649	0	0	4	0	0	0	4	2	0	0	0	0	0	0	0
	650-699	0	0	12	1	0	0	13	1	0	0	1	0	0	0	1
	700-749	0	0	17	0	0	0	17	2	0	0	12	3	0	0	15
	750-799	0	0	20	3	0	0	23	0	0	0	28	5	0	0	33
	800-849	0	0	29	0	0	0	29	4	0	0	25	25	2	0	52
	850-899	0	0	19	9	0	0	28	6	0	0	5	41	7	0	53
	900-949	0	0	4	22	0	0	26	2	0	0	2	41	5	1	49
	950-999	0	0	0	13	2	0	15	0	0	0	0	8	3	0	11
	1000-1049	0	0	0	1	0	0	1	0	0	0	0	3	3	0	6
	Mean	0	535	761	890	948	0	797(c)	782	0	0	768	860	895	895	833(c)
	SE	0	33	75	58	11	0	52	105	0	0	50	54	56	0	35
	N	0	4	106	49	2	0	161	17	0	0	73	126	20	1	220
Quinsam River																
	350-399	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	400-449	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	450-499	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	500-549	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
	550-599	0	2	1	0	0	0	3	1	0	0	0	0	0	0	0
	600-649	0	3	5	0	0	0	8	19	0	0	0	0	0	0	0
	650-699	0	0	24	1	0	0	25	30	0	0	10	0	0	0	10
	700-749	0	0	41	0	0	0	41	31	0	0	27	1	0	0	28
	750-799	0	0	58	2	0	0	60	30	0	0	54	3	1	0	58
	800-849	0	0	39	3	0	1	43	33	0	0	50	16	4	0	70
	850-899	0	0	16	7	0	2	25	8	0	0	8	41	9	1	59
	900-949	0	0	3	10	0	0	13	8	0	0	4	17	3	0	24
	950-999	0	0	2	4	0	0	6	4	0	0	1	9	1	0	11
	1000-1049	0	0	0	1	0	0	1	0	0	0	0	2	0	0	2
	Mean	0	584	743	870	0	835	744(c)	723	0	0	760	859	851	870	800(c)
	SE	0	23	67	75	0	48	57	100	0	0	53	51	45	0	36
	N	0	5	189	28	0	3	225	170	0	0	154	89	18	1	262

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 31. Age-length distribution of Campbell River, Quinsam River and Quinsam Hatchery chinook salmon, 1988. (cont.).

River	Length class (mm)	Age														
		Males (a)								Females						
		2	3	4	5	6	7	Total	Unk(b)	2	3	4	5	6	7	Total
Quinsam Hatchery																
	350-399	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0
	400-449	4	0	0	0	0	0	4	0	0	0	0	0	0	0	0
	450-499	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0
	500-549	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0
	550-599	0	6	3	0	0	0	9	1	0	0	0	0	0	0	0
	600-649	0	10	11	0	0	0	21	8	0	0	2	0	0	0	2
	650-699	0	8	46	0	0	0	54	23	0	0	15	0	0	0	15
	700-749	0	0	100	0	0	0	100	69	0	0	65	1	1	0	67
	750-799	0	0	124	2	1	0	127	63	0	0	132	6	1	0	139
	800-849	0	0	56	4	0	0	60	34	0	0	49	26	5	0	80
	850-899	0	0	20	6	1	0	27	12	0	0	11	33	12	0	56
	900-949	0	0	2	9	0	0	11	2	0	0	1	7	2	0	10
	950-999	0	0	0	1	0	0	1	0	0	0	0	0	1	0	1
	Mean	397	600	731	855	807	0	723(c)	734	0	0	746	829	836	0	768(c)
	SE	50	46	60	58	60	0	52	61	0	0	46	41	52	0	35
	N	8	26	362	22	2	0	420	212	0	0	275	73	22	0	370

(a) Includes jacks

(b) Unk = age unknown

(c) Weighted mean and standard error

Table 32. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1986. The Petersen estimates were derived using the in situ tagging method.

River and sex	Sample size (a) A	Adipose clips (b) B	Mark rate (%) C=(B/A)x100	Petersen population estimate (c) D	Percentage of population sampled E=(A/D)x100	Total estimated adipose clips F=(B/A)xD
Campbell River						
Male	997	273	27.4	1835	54.3	502
Female	1335	331	24.8	2222	60.1	551
Jack	47	4	8.5	93	50.5	8
Total	2379	608	25.6	4150	57.3	1061
Quinsam River						
Male	331	101	30.5	424	78.1	130
Female	365	128	35.1	452	80.8	160
Jack	42	8	19.0	69	60.9	13
Total	738	237	32.1	945	78.1	303
Quinsam Hatchery						
Male	1070	243	22.7	1070	100.0	243
Female	799	289	36.2	799	100.0	289
Jack	16	6	37.5	16	100.0	6
Total	1885	538	28.5	1885	100.0	538

(a) From Appendix B5 and B6
(b) From Appendix A7 and A8
(c) From Table 14

Table 33. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1987.

River and sex	Sample size (a) A	Adipose clips (b) B	Mark rate (%) C=(B/A)x100	Petersen population estimate (c) D	Percentage of population sampled E=(A/D)x100	Total estimated adipose clips F=(B/A)xD
Campbell River						
Male	601	143	23.8	1209	49.7	289
Female	797	205	25.7	1286	62.0	332
Jack	65	16	24.6	249	26.1	62
Total	1463	364	24.9	2744	53.3	683
Quinsam River						
Male	248	62	25.0	433	57.3	108
Female	588	181	30.8	885	66.4	272
Jack	340	57	16.8	870	39.1	146
Total	1176	300	25.5	2188	53.7	558
Quinsam Hatchery						
Male	1116	190	17.0	1116	100.0	190
Female	1139	339	29.8	1139	100.0	339
Jack	1108	92	8.3	1108	100.0	92
Total	3363	621	18.5	3363	100.0	621

(a) From Appendix C5 and C6
(b) From Appendix C7 and C8
(c) From Table 15

Table 34. Estimates of the total escapement of adipose clipped (CWT) fish to the Campbell and Quinsam rivers, and to the Quinsam Hatchery, 1988.

River and sex	Sample size (a) A	Adipose clips (b) B	Mark rate (%) C=(B/A)x100	Petersen population estimate (c) D	Percentage of population sampled E=(A/D)x100	Total estimated adipose clips F=(B/A)xD
Campbell River						
Male	503	56	11.1	1193	42.2	133
Female	553	72	13.0	1508	36.7	196
Jack	78	7	9.0	452	17.3	41
Total	1134	135	11.9	3153	36.0	375
Quinsam River						
Male	1058	102	9.6	2226	47.5	215
Female	1105	127	11.5	2090	52.9	240
Jack	202	16	7.9	995	20.3	79
Total	2365	245	10.4	5311	44.5	550
Quinsam Hatchery						
Male	2455	231	9.4	2455	100.0	231
Female	2160	182	8.4	2160	100.0	182
Jack	671	8	1.2	671	100.0	8
Total	5286	421	8.0	5286	100.0	421

(a) From Appendix D5 and D6
(b) From Appendix D7 and D8
(c) From Table 16

Table 35. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The source of tags for the Petersen estimates was from in situ carcass tagging. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 38.

		Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1983	22631	1	0	2.1	0.0	1	0	1.5	0.0	3	0	3.4	0.0	5	0	7.0	0.0
	22632	1	0	2.1	0.0	1	0	1.5	0.0	20	0	22.7	0.0	22	0	26.4	0.0
	82258	0	0	0.0	0.0	1	0	1.5	0.0	1	0	1.1	0.0	2	0	2.6	0.0
	82260	1	0	2.1	0.0	0	0	0.0	0.0	1	0	1.1	0.0	2	0	3.2	0.0
	82261	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	82262	0	0	0.0	0.0	1	0	1.5	0.0	0	0	0.0	0.0	1	0	1.5	0.0
	82301	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	Subtotal	3	0	6.3	0.0	4	0	6.0	0.0	27	0	30.7	0.0	34	0	43.0	0.0
1982	22518	4	4	8.4	7.6	5	2	7.5	2.9	20	17	22.7	18.8	29	23	38.7	29.3
	22519	3	1	6.3	1.9	1	3	1.5	4.4	20	18	22.7	19.9	24	22	30.6	26.1
	82046	1	1	2.1	1.9	1	1	1.5	1.5	2	0	2.3	0.0	4	2	5.9	3.4
	82047	1	0	2.1	0.0	2	0	3.0	0.0	0	1	0.0	1.1	3	1	5.1	1.1
	82048	2	0	4.2	0.0	1	0	1.5	0.0	1	1	1.1	1.1	4	1	6.9	1.1
	82049	1	2	2.1	3.8	2	1	3.0	1.5	5	4	5.7	4.4	8	7	10.8	9.7
	82050	0	1	0.0	1.9	0	0	0.0	0.0	4	4	4.5	4.4	4	5	4.5	6.3
	82051	1	0	2.1	0.0	1	1	1.5	1.5	2	0	2.3	0.0	4	1	5.9	1.5
	82052	6	0	12.6	0.0	0	1	0.0	1.5	8	3	9.1	3.3	14	4	21.7	4.8
	82053	3	1	6.3	1.9	1	2	1.5	2.9	8	8	9.1	8.8	12	11	16.9	13.6
	82054	4	1	8.4	1.9	4	3	6.0	4.4	8	3	9.1	3.3	16	7	23.5	9.6
	82055	0	1	0.0	1.9	0	0	0.0	0.0	1	1	1.1	1.1	1	2	1.1	3.0
	82056	1	1	2.1	1.9	0	1	0.0	1.5	1	4	1.1	4.4	2	6	3.2	7.8
	82057	0	0	0.0	0.0	1	0	1.5	0.0	3	0	3.4	0.0	4	0	4.9	0.0
	82058	2	0	4.2	0.0	1	2	1.5	2.9	1	1	1.1	1.1	4	3	6.9	4.0

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 35 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The source of tags for the Petersen estimates was from in situ carcass tagging. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 38.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82059	1	1	2.1	1.9	0	0	0.0	0.0	1	3	1.1	3.3	2	4	3.2	5.2
	82060	2	0	4.2	0.0	1	2	1.5	2.9	4	4	4.5	4.4	7	6	10.3	7.3
	82061	4	1	8.4	1.9	1	1	1.5	1.5	8	2	9.1	2.2	13	4	19.0	5.6
	82062	0	0	0.0	0.0	3	1	4.5	1.5	4	0	4.5	0.0	7	1	9.1	1.5
	82063	0	0	0.0	0.0	2	1	3.0	1.5	3	9	3.4	9.9	5	10	6.4	11.4
	82101	3	1	6.3	1.9	1	1	1.5	1.5	1	1	1.1	1.1	5	3	9.0	4.5
	82102	0	1	0.0	1.9	2	0	3.0	0.0	1	1	1.1	1.1	3	2	4.1	3.0
	82103	1	0	2.1	0.0	3	0	4.5	0.0	0	0	0.0	0.0	4	0	6.6	0.0
	82104	1	0	2.1	0.0	0	0	0.0	0.0	7	0	8.0	0.0	8	0	10.1	0.0
	82105	1	1	2.1	1.9	1	1	1.5	1.5	2	2	2.3	2.2	4	4	5.9	5.6
	82106	2	1	4.2	1.9	0	0	0.0	0.0	6	0	6.8	0.0	8	1	11.0	1.9
	82107	2	1	4.2	1.9	5	0	7.5	0.0	5	2	5.7	2.2	12	3	17.4	4.1
	82108	1	0	2.1	0.0	2	0	3.0	0.0	1	2	1.1	2.2	4	2	6.3	2.2
	82109	3	1	6.3	1.9	2	2	3.0	2.9	3	1	3.4	1.1	8	4	12.7	5.9
	82110	1	0	2.1	0.0	2	0	3.0	0.0	2	1	2.3	1.1	5	1	7.4	1.1
	82111	0	2	0.0	3.8	0	1	0.0	1.5	0	0	0.0	0.0	0	3	0.0	5.3
	82112	1	1	2.1	1.9	1	0	1.5	0.0	1	1	1.1	1.1	3	2	4.7	3.0
	82113	1	0	2.1	0.0	1	0	1.5	0.0	1	0	1.1	0.0	3	0	4.7	0.0
	82114	1	0	2.1	0.0	0	0	0.0	0.0	3	1	3.4	1.1	4	1	5.5	1.1
	82115	3	0	6.3	0.0	2	0	3.0	0.0	2	0	2.3	0.0	7	0	11.6	0.0
	82148	0	1	0.0	1.9	1	0	1.5	0.0	2	0	2.3	0.0	3	1	3.8	1.9
	82151	2	0	4.2	0.0	1	0	1.5	0.0	1	1	1.1	1.1	4	1	6.9	1.1
	82154	1	0	2.1	0.0	1	0	1.5	0.0	2	3	2.3	3.3	4	3	5.9	3.3
	82207	0	0	0.0	0.0	2	1	3.0	1.5	1	3	1.1	3.3	3	4	4.1	4.8

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 35 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The source of tags for the Petersen estimates was from in situ carcass tagging. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 38.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82208	2	0	4.2	0.0	1	0	1.5	0.0	0	7	0.0	7.7	3	7	5.7	7.7
	82209	1	0	2.1	0.0	2	1	3.0	1.5	2	3	2.3	3.3	5	4	7.4	4.8
	82210	3	0	6.3	0.0	3	0	4.5	0.0	4	0	4.5	0.0	10	0	15.4	0.0
	82211	2	1	4.2	1.9	4	0	6.0	0.0	1	7	1.1	7.7	7	8	11.4	9.6
	82212	0	0	0.0	0.0	2	2	3.0	2.9	5	1	5.7	1.1	7	3	8.7	4.0
	82214	0	1	0.0	1.9	0	0	0.0	0.0	0	3	0.0	3.3	0	4	0.0	5.2
	82215	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	82216	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	82217	0	0	0.0	0.0	0	0	0.0	0.0	0	3	0.0	3.3	0	3	0.0	3.3
	82219	0	3	0.0	5.7	1	0	1.5	0.0	1	1	1.1	1.1	2	4	2.6	6.8
	Subtotal	68	30	143.3	57.0	67	31	100.9	45.1	159	128	180.8	141.2	294	189	424.9	243.3
1981	22303	29	47	61.1	89.3	5	10	7.5	14.5	2	7	2.3	7.7	36	64	70.9	111.6
	22304	16	32	33.7	60.8	0	10	0.0	14.5	7	25	8.0	27.6	23	67	41.7	102.9
	82119	2	3	4.2	5.7	0	1	0.0	1.5	0	2	0.0	2.2	2	6	4.2	9.4
	82120	0	5	0.0	9.5	0	3	0.0	4.4	0	3	0.0	3.3	0	11	0.0	17.2
	82121	0	1	0.0	1.9	0	0	0.0	0.0	1	2	1.1	2.2	1	3	1.1	4.1
	82122	4	6	8.4	11.4	2	1	3.0	1.5	0	3	0.0	3.3	6	10	11.4	16.2
	82123	1	3	2.1	5.7	2	1	3.0	1.5	1	3	1.1	3.3	4	7	6.3	10.5
	82124	2	3	4.2	5.7	1	2	1.5	2.9	1	3	1.1	3.3	4	8	6.9	11.9
	82125	5	12	10.5	22.8	1	4	1.5	5.8	0	2	0.0	2.2	6	18	12.0	30.8
	82126	6	5	12.6	9.5	1	5	1.5	7.3	1	4	1.1	4.4	8	14	15.3	21.2
	82127	4	6	8.4	11.4	1	4	1.5	5.8	1	4	1.1	4.4	6	14	11.1	21.6
	82128	4	11	8.4	20.9	1	1	1.5	1.5	2	5	2.3	5.5	7	17	12.2	27.9

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 35 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The source of tags for the Petersen estimates was from in situ carcass tagging. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 38.

		Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82129	6	8	12.6	15.2	0	2	0.0	2.9	1	5	1.1	5.5	7	15	13.8	23.6
	82130	7	5	14.8	9.5	0	4	0.0	5.8	1	2	1.1	2.2	8	11	15.9	17.5
	82131	5	9	10.5	17.1	1	2	1.5	2.9	0	1	0.0	1.1	6	12	12.0	21.1
	82132	8	6	16.9	11.4	1	2	1.5	2.9	1	2	1.1	2.2	10	10	19.5	16.5
	82133	6	5	12.6	9.5	0	2	0.0	2.9	0	5	0.0	5.5	6	12	12.6	17.9
	82134	8	4	16.9	7.6	1	1	1.5	1.5	0	2	0.0	2.2	9	7	18.4	11.3
	82135	2	7	4.2	13.3	0	2	0.0	2.9	3	2	3.4	2.2	5	11	7.6	18.4
	82136	3	8	6.3	15.2	0	1	0.0	1.5	2	2	2.3	2.2	5	11	8.6	18.9
	82137	6	5	12.6	9.5	0	1	0.0	1.5	0	3	0.0	3.3	6	9	12.6	14.3
	82138	5	7	10.5	13.3	2	3	3.0	4.4	1	4	1.1	4.4	8	14	14.7	22.1
	82139	4	3	8.4	5.7	0	1	0.0	1.5	2	4	2.3	4.4	6	8	10.7	11.6
	82140	2	3	4.2	5.7	0	2	0.0	2.9	0	4	0.0	4.4	2	9	4.2	13.0
	82141	4	7	8.4	13.3	1	2	1.5	2.9	1	3	1.1	3.3	6	12	11.1	19.5
	82142	1	5	2.1	9.5	0	2	0.0	2.9	1	6	1.1	6.6	2	13	3.2	19.0
	82143	6	4	12.6	7.6	0	2	0.0	2.9	0	3	0.0	3.3	6	9	12.6	13.8
	82144	1	8	2.1	15.2	0	4	0.0	5.8	0	3	0.0	3.3	1	15	2.1	24.3
	82145	6	7	12.6	13.3	0	0	0.0	0.0	1	5	1.1	5.5	7	12	13.8	18.8
	82146	2	3	4.2	5.7	1	0	1.5	0.0	0	2	0.0	2.2	3	5	5.7	7.9
	82147	3	6	6.3	11.4	0	0	0.0	0.0	0	3	0.0	3.3	3	9	6.3	14.7
	82149	1	6	2.1	11.4	1	1	1.5	1.5	1	1	1.1	1.1	3	8	4.7	14.0
	82150	3	2	6.3	3.8	0	0	0.0	0.0	0	0	0.0	0.0	3	2	6.3	3.8
	82152	4	7	8.4	13.3	1	1	1.5	1.5	2	3	2.3	3.3	7	11	12.2	18.1
	82153	5	0	10.5	0.0	1	2	1.5	2.9	0	4	0.0	4.4	6	6	12.0	7.3
	Subtotal	171	259	360.4	492.1	24	79	36.1	114.9	33	132	37.5	145.6	228	470	434.0	752.6

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 35 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The source of tags for the Petersen estimates was from in situ carcass tagging. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 38.

		Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1980	21657	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	21943	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	21950	0	1	0.0	1.9	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.9
	Subtotal	0	1	0.0	1.9	0	0	0.0	0.0	0	2	0.0	2.2	0	3	0.0	4.1
Total decoded		242	290	510	551	95	110	143	160	219	262	249	289	556	662	902	1000
Not decoded		35	41			14	18			30	27			79	86		
Grand total		277	331			109	128			249	289			635	748		

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 36. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 39.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1985	23555	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.6	0.0	1	0	1.6	0.0
	Subtotal	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.6	0.0	1	0	1.6	0.0
1984	23322	0	0	0.0	0.0	2	1	5.4	1.7	2	0	3.2	0.0	4	1	8.6	1.7
	23323	1	0	2.5	0.0	1	0	2.7	0.0	6	1	9.5	1.1	8	1	14.7	1.1
	23324	0	0	0.0	0.0	0	0	0.0	0.0	4	0	6.3	0.0	4	0	6.3	0.0
	23325	2	0	5.1	0.0	6	0	16.2	0.0	0	0	0.0	0.0	8	0	21.3	0.0
	23326	1	0	2.5	0.0	2	0	5.4	0.0	0	0	0.0	0.0	3	0	7.9	0.0
	23327	2	0	5.1	0.0	2	0	5.4	0.0	0	0	0.0	0.0	4	0	10.5	0.0
	23328	1	0	2.5	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	2.5	0.0
	23329	0	0	0.0	0.0	5	0	13.5	0.0	0	0	0.0	0.0	5	0	13.5	0.0
	23330	0	0	0.0	0.0	1	0	2.7	0.0	0	0	0.0	0.0	1	0	2.7	0.0
	82351	1	0	2.5	0.0	1	0	2.7	0.0	0	0	0.0	0.0	2	0	5.2	0.0
	82353	1	0	2.5	0.0	3	0	8.1	0.0	0	0	0.0	0.0	4	0	10.6	0.0
	82355	0	0	0.0	0.0	3	0	8.1	0.0	0	0	0.0	0.0	3	0	8.1	0.0
	82356	2	0	5.1	0.0	4	0	10.8	0.0	0	0	0.0	0.0	6	0	15.9	0.0
	82357	1	0	2.5	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	2.5	0.0
	82358	0	0	0.0	0.0	2	0	5.4	0.0	0	0	0.0	0.0	2	0	5.4	0.0
	82359	0	0	0.0	0.0	1	0	2.7	0.0	0	0	0.0	0.0	1	0	2.7	0.0
	82360	0	0	0.0	0.0	3	0	8.1	0.0	0	0	0.0	0.0	3	0	8.1	0.0
	82361	0	0	0.0	0.0	1	0	2.7	0.0	0	0	0.0	0.0	1	0	2.7	0.0
	Subtotal	12	0	30.3	0.0	37	1	100.0	1.7	12	1	19.0	1.1	61	2	149.3	2.7
1983	22631	9	3	22.7	5.4	5	7	13.5	11.7	13	5	20.6	5.3	27	15	56.8	22.4
	22632	9	4	22.7	7.2	4	0	10.8	0.0	18	14	28.5	14.9	31	18	62.1	22.1
	82220	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.6	0.0	1	0	1.6	0.0

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 36 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1987. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 39.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82221	1	0	2.5	0.0	1	1	2.7	1.7	0	0	0.0	0.0	2	1	5.2	1.7
	82257	2	0	5.1	0.0	0	1	0.0	1.7	2	0	3.2	0.0	4	1	8.2	1.7
	82258	1	0	2.5	0.0	0	0	0.0	0.0	1	0	1.6	0.0	2	0	4.1	0.0
	82259	0	0	0.0	0.0	4	0	10.8	0.0	0	0	0.0	0.0	4	0	10.8	0.0
	82260	0	0	0.0	0.0	1	1	2.7	1.7	1	1	1.6	1.1	2	2	4.3	2.7
	82261	1	0	2.5	0.0	1	2	2.7	3.3	1	1	1.6	1.1	3	3	6.8	4.4
	82262	4	0	10.1	0.0	0	1	0.0	1.7	3	0	4.8	0.0	7	1	14.9	1.7
	82263	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	82301	1	0	2.5	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	2.5	0.0
	82302	1	2	2.5	3.6	0	0	0.0	0.0	0	0	0.0	0.0	1	2	2.5	3.6
	Subtotal	29	9	73.2	16.2	16	13	43.2	21.7	40	22	63.4	23.5	85	44	179.8	61.3
1982	22518	7	5	17.7	9.0	6	9	16.2	15.0	8	16	12.7	17.1	21	30	46.6	41.0
	22519	4	5	10.1	9.0	1	2	2.7	3.3	8	23	12.7	24.5	13	30	25.5	36.8
	82046	3	2	7.6	3.6	1	5	2.7	8.3	2	7	3.2	7.5	6	14	13.4	19.4
	82047	0	2	0.0	3.6	0	3	0.0	5.0	1	5	1.6	5.3	1	10	1.6	13.9
	82048	0	2	0.0	3.6	1	4	2.7	6.7	2	4	3.2	4.3	3	10	5.9	14.5
	82049	2	5	5.1	9.0	2	3	5.4	5.0	6	8	9.5	8.5	10	16	20.0	22.5
	82050	3	4	7.6	7.2	4	1	10.8	1.7	3	5	4.8	5.3	10	10	23.1	14.2
	82051	3	7	7.6	12.6	0	7	0.0	11.7	3	10	4.8	10.7	6	24	12.3	34.9
	82052	0	3	0.0	5.4	0	4	0.0	6.7	5	9	7.9	9.6	5	16	7.9	21.7
	82053	4	1	10.1	1.8	1	1	2.7	1.7	4	6	6.3	6.4	9	8	19.1	9.9
	82054	1	4	2.5	7.2	1	2	2.7	3.3	6	9	9.5	9.6	8	15	14.7	20.1
	82055	1	2	2.5	3.6	0	4	0.0	6.7	4	2	6.3	2.1	5	8	8.9	12.4
	82056	1	3	2.5	5.4	1	5	2.7	8.3	2	11	3.2	11.7	4	19	8.4	25.5
	82057	1	2	2.5	3.6	1	4	2.7	6.7	2	7	3.2	7.5	4	13	8.4	17.7

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 36 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1987. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 39.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82058	2	4	5.1	7.2	1	1	2.7	1.7	1	9	1.6	9.6	4	14	9.3	18.4
	82059	2	2	5.1	3.6	1	4	2.7	6.7	4	4	6.3	4.3	7	10	14.1	14.5
	82060	1	2	2.5	3.6	2	1	5.4	1.7	1	8	1.6	8.5	4	11	9.5	13.8
	82061	1	3	2.5	5.4	1	3	2.7	5.0	0	10	0.0	10.7	2	16	5.2	21.1
	82062	1	2	2.5	3.6	1	4	2.7	6.7	4	4	6.3	4.3	6	10	11.6	14.5
	82063	2	1	5.1	1.8	0	4	0.0	6.7	0	7	0.0	7.5	2	12	5.1	15.9
	82101	0	3	0.0	5.4	0	5	0.0	8.3	1	4	1.6	4.3	1	12	1.6	18.0
	82102	1	2	2.5	3.6	2	3	5.4	5.0	1	5	1.6	5.3	4	10	9.5	13.9
	82103	1	1	2.5	1.8	0	4	0.0	6.7	7	6	11.1	6.4	8	11	13.6	14.9
	82104	1	4	2.5	7.2	1	3	2.7	5.0	5	0	7.9	0.0	7	7	13.1	12.2
	82105	3	2	7.6	3.6	2	2	5.4	3.3	3	7	4.8	7.5	8	11	17.7	14.4
	82106	4	2	10.1	3.6	1	2	2.7	3.3	1	6	1.6	6.4	6	10	14.4	13.3
	82107	4	0	10.1	0.0	0	0	0.0	0.0	3	3	4.8	3.2	7	3	14.9	3.2
	82108	3	3	7.6	5.4	0	2	0.0	3.3	2	8	3.2	8.5	5	13	10.7	17.2
	82109	2	2	5.1	3.6	1	6	2.7	10.0	0	6	0.0	6.4	3	14	7.8	20.0
	82110	1	3	2.5	5.4	1	2	2.7	3.3	1	2	1.6	2.1	3	7	6.8	10.9
	82111	1	0	2.5	0.0	0	2	0.0	3.3	0	4	0.0	4.3	1	6	2.5	7.6
	82112	1	2	2.5	3.6	0	1	0.0	1.7	1	4	1.6	4.3	2	7	4.1	9.5
	82113	2	3	5.1	5.4	0	2	0.0	3.3	2	3	3.2	3.2	4	8	8.2	11.9
	82114	3	5	7.6	9.0	0	1	0.0	1.7	2	2	3.2	2.1	5	8	10.7	12.8
	82115	0	4	0.0	7.2	0	3	0.0	5.0	5	2	7.9	2.1	5	9	7.9	14.3
	82148	0	1	0.0	1.8	0	1	0.0	1.7	1	5	1.6	5.3	1	7	1.6	8.8
	82151	1	1	2.5	1.8	1	2	2.7	3.3	1	4	1.6	4.3	3	7	6.8	9.4
	82154	2	4	5.1	7.2	0	3	0.0	5.0	2	2	3.2	2.1	4	9	8.2	14.3
	82207	1	1	2.5	1.8	0	2	0.0	3.3	1	5	1.6	5.3	2	8	4.1	10.5
	82208	2	1	5.1	1.8	1	0	2.7	0.0	6	4	9.5	4.3	9	5	17.3	6.1

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 36 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1987. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 39.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82209	2	0	5.1	0.0	1	1	2.7	1.7	2	4	3.2	4.3	5	5	10.9	5.9
	82210	2	1	5.1	1.8	0	1	0.0	1.7	1	5	1.6	5.3	3	7	6.6	8.8
	82211	0	4	0.0	7.2	1	3	2.7	5.0	1	5	1.6	5.3	2	12	4.3	17.5
	82212	1	3	2.5	5.4	1	1	2.7	1.7	2	0	3.2	0.0	4	4	8.4	7.1
	82214	2	0	5.1	0.0	0	1	0.0	1.7	0	0	0.0	0.0	2	1	5.1	1.7
	82215	1	0	2.5	0.0	0	0	0.0	0.0	0	1	0.0	1.1	1	1	2.5	1.1
	82216	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	82217	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.6	0.0	1	0	1.6	0.0
	82218	0	0	0.0	0.0	0	0	0.0	0.0	0	3	0.0	3.2	0	3	0.0	3.2
	82219	0	1	0.0	1.8	0	1	0.0	1.7	1	0	1.6	0.0	1	2	1.6	3.5
	Subtotal	80	114	0 202.0	204.6	38	125	102.7	208.6	119	265	188.5	282.5	237	504	493.2	695.7
1981	22303	2	10	5.1	17.9	0	2	0.0	3.3	0	2	0.0	2.1	2	14	5.1	23.4
	22304	0	7	0.0	12.6	0	6	0.0	10.0	1	2	1.6	2.1	1	15	1.6	24.7
	82119	1	0	2.5	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	2.5	0.0
	82120	0	2	0.0	3.6	0	1	0.0	1.7	0	2	0.0	2.1	0	5	0.0	7.4
	82121	2	0	5.1	0.0	0	1	0.0	1.7	1	0	1.6	0.0	3	1	6.6	1.7
	82122	0	0	0.0	0.0	0	1	0.0	1.7	0	0	0.0	0.0	0	1	0.0	1.7
	82123	0	1	0.0	1.8	1	0	2.7	0.0	0	0	0.0	0.0	1	1	2.7	1.8
	82124	0	3	0.0	5.4	0	1	0.0	1.7	0	2	0.0	2.1	0	6	0.0	9.2
	82125	1	2	2.5	3.6	0	0	0.0	0.0	0	1	0.0	1.1	1	3	2.5	4.7
	82126	0	4	0.0	7.2	0	0	0.0	0.0	1	1	1.6	1.1	1	5	1.6	8.2
	82127	0	0	0.0	0.0	1	1	2.7	1.7	0	0	0.0	0.0	1	1	2.7	1.7
	82128	1	2	2.5	3.6	0	0	0.0	0.0	0	2	0.0	2.1	1	4	2.5	5.7
	82129	0	2	0.0	3.6	0	0	0.0	0.0	0	2	0.0	2.1	0	4	0.0	5.7
	82130	2	2	5.1	3.6	0	1	0.0	1.7	0	0	0.0	0.0	2	3	5.1	5.3

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 36 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1987. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 39.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82131	0	3	0.0	5.4	0	0	0.0	0.0	1	0	1.6	0.0	1	3	1.6	5.4
	82132	1	0	2.5	0.0	0	1	0.0	1.7	0	0	0.0	0.0	1	1	2.5	1.7
	82133	0	3	0.0	5.4	0	0	0.0	0.0	0	2	0.0	2.1	0	5	0.0	7.5
	82134	0	2	0.0	3.6	0	1	0.0	1.7	0	0	0.0	0.0	0	3	0.0	5.3
	82135	0	3	0.0	5.4	0	1	0.0	1.7	1	1	1.6	1.1	1	5	1.6	8.1
	82136	1	2	2.5	3.6	0	1	0.0	1.7	0	1	0.0	1.1	1	4	2.5	6.3
	82137	2	1	5.1	1.8	0	1	0.0	1.7	0	0	0.0	0.0	2	2	5.1	3.5
	82138	0	2	0.0	3.6	0	0	0.0	0.0	0	1	0.0	1.1	0	3	0.0	4.7
	82139	2	0	5.1	0.0	0	2	0.0	3.3	0	0	0.0	0.0	2	2	5.1	3.3
	82140	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	82141	0	1	0.0	1.8	0	1	0.0	1.7	0	0	0.0	0.0	0	2	0.0	3.5
	82142	1	0	2.5	0.0	0	0	0.0	0.0	1	0	1.6	0.0	2	0	4.1	0.0
	82143	1	2	2.5	3.6	0	1	0.0	1.7	0	1	0.0	1.1	1	4	2.5	6.3
	82144	0	2	0.0	3.6	1	0	2.7	0.0	0	1	0.0	1.1	1	3	2.7	4.7
	82145	1	2	2.5	3.6	0	0	0.0	0.0	0	1	0.0	1.1	1	3	2.5	4.7
	82146	0	2	0.0	3.6	0	1	0.0	1.7	0	2	0.0	2.1	0	5	0.0	7.4
	82147	0	0	0.0	0.0	0	0	0.0	0.0	0	2	0.0	2.1	0	2	0.0	2.1
	82149	0	2	0.0	3.6	0	0	0.0	0.0	0	2	0.0	2.1	0	4	0.0	5.7
	82150	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.1	0	1	0.0	1.1
	Subtotal	18	62	45.5	111.3	3	24	8.1	40.0	6	30	9.5	32.0	27	116	63.1	183.3
Total decoded		139	185	351	332	94	163	254	272	178	318	282	339	411	666	887	943
Not decoded		20	20			25	18			104	21			149	59		
Grand Total		159	205			119	181			282	339			560	725		

(a) Abreviations are M = male and F = female
(b) Includes jacks

Table 37. Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1988. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 40.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1986	24158	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	Subtotal	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
1985	23522	0	0	0.0	0.0	1	0	3.2	0.0	1	0	1.1	0.0	2	0	4.2	0.0
	23523	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	23524	0	0	0.0	0.0	0	0	0.0	0.0	2	0	2.1	0.0	2	0	2.1	0.0
	23525	0	0	0.0	0.0	1	0	3.2	0.0	5	0	5.4	0.0	6	0	8.5	0.0
	23554	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	23555	0	0	0.0	0.0	0	0	0.0	0.0	2	0	2.1	0.0	2	0	2.1	0.0
	23556	0	0	0.0	0.0	0	0	0.0	0.0	1	0	1.1	0.0	1	0	1.1	0.0
	23645	1	0	3.3	0.0	0	0	0.0	0.0	2	0	2.1	0.0	3	0	5.5	0.0
	Subtotal	1	0	3.3	0.0	2	0	6.3	0.0	15	0	16.1	0.0	18	0	25.7	0.0
1984	23322	1	2	3.3	6.0	3	6	9.5	12.4	7	4	7.5	4.1	11	12	20.3	22.6
	23323	0	1	0.0	3.0	2	2	6.3	4.1	11	8	11.8	8.2	13	11	18.1	15.4
	23324	2	1	6.7	3.0	4	4	12.6	8.3	5	8	5.4	8.2	11	13	24.7	19.5
	23325	4	0	13.4	0.0	5	8	15.8	16.6	21	19	22.5	19.5	30	27	51.7	36.1
	23326	3	5	10.0	15.1	5	8	15.8	16.6	21	13	22.5	13.4	29	26	48.4	45.0
	23327	1	1	3.3	3.0	7	6	22.1	12.4	27	22	28.9	22.6	35	29	54.4	38.1
	23328	1	4	3.3	12.1	7	8	22.1	16.6	18	6	19.3	6.2	26	18	44.8	34.8
	23329	1	2	3.3	6.0	9	5	28.5	10.3	27	11	28.9	11.3	37	18	60.7	27.7
	23330	0	1	0.0	3.0	9	2	28.5	4.1	19	12	20.4	12.3	28	15	48.8	19.5
	82351	1	0	3.3	0.0	2	0	6.3	0.0	3	0	3.2	0.0	6	0	12.9	0.0
	82352	0	1	0.0	3.0	2	2	6.3	4.1	5	2	5.4	2.1	7	5	11.7	9.2
	82353	2	1	6.7	3.0	3	0	9.5	0.0	5	1	5.4	1.0	10	2	21.5	4.0
	82354	2	0	6.7	0.0	1	1	3.2	2.1	3	1	3.2	1.0	6	2	13.1	3.1

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 37 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1988. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 40.

		Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	82355	2	1	6.7	3.0	2	3	6.3	6.2	3	1	3.2	1.0	7	5	16.2	10.3
	82356	2	0	6.7	0.0	3	0	9.5	0.0	1	2	1.1	2.1	6	2	17.2	2.1
	82357	2	0	6.7	0.0	3	5	9.5	10.3	2	2	2.1	2.1	7	7	18.3	12.4
	82358	2	1	6.7	3.0	3	2	9.5	4.1	3	2	3.2	2.1	8	5	19.4	9.2
	82359	0	1	0.0	3.0	2	2	6.3	4.1	3	3	3.2	3.1	5	6	9.5	10.2
	82360	1	2	3.3	6.0	1	0	3.2	0.0	2	2	2.1	2.1	4	4	8.7	8.1
	82361	0	0	0.0	0.0	0	0	0.0	0.0	1	3	1.1	3.1	1	3	1.1	3.1
	82362	0	2	0.0	6.0	0	2	0.0	4.1	2	0	2.1	0.0	2	4	2.1	10.2
	Subtotal	27	26	90.3	78.4	73	66	230.8	136.6	189	122	202.6	125.4	289	214	523.7	340.4
1983	22631	6	5	20.1	15.1	6	8	19.0	16.6	4	13	4.3	13.4	16	26	43.3	45.0
	22632	8	8	26.8	24.1	4	13	12.6	26.9	5	15	5.4	15.4	17	36	44.8	66.4
	82213	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.0	0	1	0.0	1.0
	82220	1	0	3.3	0.0	1	0	3.2	0.0	0	0	0.0	0.0	2	0	6.5	0.0
	82221	1	0	3.3	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	3.3	0.0
	82257	0	2	0.0	6.0	1	3	3.2	6.2	3	2	3.2	2.1	4	7	6.4	14.3
	82258	0	1	0.0	3.0	1	2	3.2	4.1	1	0	1.1	0.0	2	3	4.2	7.2
	82259	0	0	0.0	0.0	0	2	0.0	4.1	1	2	1.1	2.1	1	4	1.1	6.2
	82260	2	2	6.7	6.0	1	0	3.2	0.0	2	0	2.1	0.0	5	2	12.0	6.0
	82261	2	2	6.7	6.0	0	0	0.0	0.0	0	0	0.0	0.0	2	2	6.7	6.0
	82262	2	3	6.7	9.0	1	1	3.2	2.1	0	1	0.0	1.0	3	5	9.9	12.1
	82263	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	82301	0	1	0.0	3.0	0	1	0.0	2.1	0	0	0.0	0.0	0	2	0.0	5.1
	82302	0	1	0.0	3.0	0	2	0.0	4.1	0	0	0.0	0.0	0	3	0.0	7.2
	Subtotal	22	25	73.6	75.4	15	33	47.4	68.3	16	34	17.1	35.0	53	92	138.2	178.6

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 37 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1988. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 40.

Brood year	CWT code	Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
		M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1982	22518	0	0	0.0	0.0	0	0	0.0	0.0	0	2	0.0	2.1	0	2	0.0	2.1
	22519	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.0	0	1	0.0	1.0
	82046	0	0	0.0	0.0	0	0	0.0	0.0	0	4	0.0	4.1	0	4	0.0	4.1
	82048	0	1	0.0	3.0	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	3.0
	82049	0	3	0.0	9.0	0	1	0.0	2.1	0	0	0.0	0.0	0	4	0.0	11.1
	82052	0	1	0.0	3.0	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	3.0
	82054	0	1	0.0	3.0	0	1	0.0	2.1	0	0	0.0	0.0	0	2	0.0	5.1
	82055	0	0	0.0	0.0	0	0	0.0	0.0	0	2	0.0	2.1	0	2	0.0	2.1
	82056	0	0	0.0	0.0	0	0	0.0	0.0	0	2	0.0	2.1	0	2	0.0	2.1
	82057	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.0	0	1	0.0	1.0
	82058	0	0	0.0	0.0	0	1	0.0	2.1	0	1	0.0	1.0	0	2	0.0	3.1
	82059	0	0	0.0	0.0	0	1	0.0	2.1	0	2	0.0	2.1	0	3	0.0	4.1
	82061	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	82062	0	1	0.0	3.0	0	2	0.0	4.1	0	2	0.0	2.1	0	5	0.0	9.2
	82063	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.0	0	1	0.0	1.0
	82102	0	1	0.0	3.0	0	3	0.0	6.2	0	0	0.0	0.0	0	4	0.0	9.2
	82104	0	1	0.0	3.0	0	0	0.0	0.0	0	1	0.0	1.0	0	2	0.0	4.0
	82105	0	0	0.0	0.0	0	2	0.0	4.1	0	0	0.0	0.0	0	2	0.0	4.1
	82106	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	1.0	0	1	0.0	1.0
	82107	1	0	3.3	0.0	0	0	0.0	0.0	0	1	0.0	1.0	1	1	3.3	1.0
	82111	0	1	0.0	3.0	0	1	0.0	2.1	1	0	1.1	0.0	1	2	1.1	5.1
	82113	1	0	3.3	0.0	0	0	0.0	0.0	0	0	0.0	0.0	1	0	3.3	0.0
	82114	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	82154	0	1	0.0	3.0	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	3.0
	82207	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	82208	0	1	0.0	3.0	0	0	0.0	0.0	1	0	1.1	0.0	1	1	1.1	3.0

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 37 (cont.). Estimates of total escapement of adipose clipped chinook salmon to the Campbell River, Quinsam River, and Quinsam hatchery by tag code, 1988. One decimal place is carried for the estimated adipose clips for calculating expanded hatchery contribution in Table 40.

		Campbell River (a)				Quinsam River				Quinsam Hatchery				Total			
		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips		Observed adipose clips		Estimated adipose clips	
Brood year	CWT code	M (b)	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1982	82209	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	82210	0	1	0.0	3.0	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	3.0
	82211	0	0	0.0	0.0	0	1	0.0	2.1	0	0	0.0	0.0	0	1	0.0	2.1
	Subtotal	2	13	6.7	39.2	0	17	0.0	35.2	2	21	2.1	21.6	4	51	8.8	96.0
1981	82123	0	0	0.0	0.0	1	0	3.2	0.0	0	0	0.0	0.0	1	0	3.2	0.0
	82136	0	0	0.0	0.0	1	0	3.2	0.0	0	0	0.0	0.0	1	0	3.2	0.0
	82144	0	0	0.0	0.0	1	0	3.2	0.0	0	0	0.0	0.0	1	0	3.2	0.0
	82149	0	1	0.0	3.0	0	0	0.0	0.0	0	0	0.0	0.0	0	1	0.0	3.0
	Subtotal	0	1	0.0	3.0	3	0	9.5	0.0	0	0	0.0	0.0	3	1	9.5	3.0
Total decoded		52	65	174	196	93	116	294	240	223	177	239	182	368	358	707	618
Not decoded		11	7			25	11			16	5			52	23		
Grand Total		63	72			118	127			239	182			420	381		

(a) Abreviations are M = male and F = female
(b) Includes jacks

Table 38. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 35) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1983	22631	49499	619827	13.52	28	0	20	0	46	0	95	0
	22632	50069	586484	12.71	27	0	19	0	289	0	335	0
	82258	10878	810	1.07	0	0	2	0	1	0	3	0
	82260	12173	149	1.01	2	0	0	0	1	0	3	0
	82261	11633	142	1.01	0	0	0	0	1	0	1	0
	82262	11465	140	1.01	0	0	2	0	0	0	2	0
	82301	11641	47	1.00	0	0	0	0	1	0	1	0
	Subtotal				57	0	43	0	340	0	440	0
1982	22518	36234	268167	8.40	71	64	63	24	191	158	325	246
	22519	35375	247913	8.01	51	15	12	35	182	159	245	209
	82046	9763	196	1.02	2	2	2	1	2	0	6	3
	82047	9846	197	1.02	2	0	3	0	0	1	5	1
	82048	10159	204	1.02	4	0	2	0	1	1	7	1
	82049	10637	213	1.02	2	4	3	1	6	5	11	10
	82050	9803	196	1.02	0	2	0	0	5	5	5	6
	82051	9880	198	1.02	2	0	2	1	2	0	6	1
	82052	10221	205	1.02	13	0	0	1	9	3	22	5
	82053	9794	196	1.02	6	2	2	3	9	9	17	14
	82054	9812	196	1.02	9	2	6	4	9	3	24	10
	82055	10494	179	1.02	0	2	0	0	1	1	1	3
	82056	9855	168	1.02	2	2	0	1	1	4	3	8
	82057	9935	169	1.02	0	0	2	0	3	0	5	0
	82058	10014	170	1.02	4	0	2	3	1	1	7	4

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 38 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 35) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82059	9870	168	1.02	2	2	0	0	1	3	3	5
	82060	9932	169	1.02	4	0	2	3	5	4	10	7
	82061	9831	167	1.02	9	2	2	1	9	2	19	6
	82062	9882	168	1.02	0	0	5	1	5	0	9	1
	82063	10160	173	1.02	0	0	3	1	3	10	7	12
	82101	9915	112	1.01	6	2	2	1	1	1	9	5
	82102	10176	115	1.01	0	2	3	0	1	1	4	3
	82103	9884	112	1.01	2	0	5	0	0	0	7	0
	82104	9928	113	1.01	2	0	0	0	8	0	10	0
	82105	9946	113	1.01	2	2	2	1	2	2	6	6
	82106	9944	113	1.01	4	2	0	0	7	0	11	2
	82107	9937	113	1.01	4	2	8	0	6	2	18	4
	82108	9922	112	1.01	2	0	3	0	1	2	6	2
	82109	9954	113	1.01	6	2	3	3	3	1	13	6
	82110	9842	240	1.02	2	0	3	0	2	1	8	1
	82111	9822	240	1.02	0	4	0	1	0	0	0	5
	82112	9883	241	1.02	2	2	2	0	1	1	5	3
	82113	9872	241	1.02	2	0	2	0	1	0	5	0
	82114	9812	240	1.02	2	0	0	0	3	1	6	1
	82115	9875	241	1.02	6	0	3	0	2	0	12	0
	82148	10547	237	1.02	0	2	2	0	2	0	4	2
	82151	9816	240	1.02	4	0	2	0	1	1	7	1
	82154	10021	245	1.02	2	0	2	0	2	3	6	3
	82207	11096	585	1.05	0	0	3	2	1	3	4	5

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 38 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 35) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82208	11039	582	1.05	4	0	2	0	0	8	6	8
	82209	11021	581	1.05	2	0	3	2	2	3	8	5
	82210	11413	233	1.02	6	0	5	0	5	0	16	0
	82211	11666	239	1.02	4	2	6	0	1	8	12	10
	82212	11499	235	1.02	0	0	3	3	6	1	9	4
	82214	11178	467	1.04	0	2	0	0	0	3	0	5
	82215	11107	463	1.04	0	0	0	0	0	1	0	1
	82216	11499	155	1.01	0	0	0	0	1	0	1	0
	82217	11501	155	1.01	0	0	0	0	0	3	0	3
	82219	11168	466	1.04	0	6	2	0	1	1	3	7
	Subtotal				253	128	169	98	511	422	933	647
1981	22303	49802	130371	3.62	221	323	27	53	8	28	257	404
	22304	49953	208280	5.17	174	314	0	75	41	143	215	532
	82119	6740	470	1.07	5	6	0	2	0	2	5	10
	82120	9215	212	1.02	0	10	0	4	0	3	0	18
	82121	8782	220	1.03	0	2	0	0	1	2	1	4
	82122	9761	256	1.03	9	12	3	1	0	3	12	17
	82123	10070	178	1.02	2	6	3	1	1	3	6	11
	82124	10108	164	1.02	4	6	2	3	1	3	7	12
	82125	9539	867	1.09	11	25	2	6	0	2	13	34
	82126	9754	667	1.07	14	10	2	8	1	5	16	23
	82127	9622	675	1.07	9	12	2	6	1	5	12	23
	82128	9434	708	1.08	9	22	2	2	2	6	13	30

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 38 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 35) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82129	9590	581	1.06	13	16	0	3	1	6	15	25
	82130	9072	865	1.10	16	10	0	6	1	2	17	19
	82131	10184	186	1.02	11	17	2	3	0	1	12	21
	82132	10302	160	1.02	17	12	2	3	1	2	20	17
	82133	9776	213	1.02	13	10	0	3	0	6	13	18
	82134	10205	100	1.01	17	8	2	1	0	2	19	11
	82135	10394	106	1.01	4	13	0	3	3	2	8	19
	82136	10169	0	1.00	6	15	0	1	2	2	9	19
	82137	9478	653	1.07	14	10	0	2	0	4	14	15
	82138	9763	610	1.06	11	14	3	5	1	5	16	23
	82139	9400	559	1.06	9	6	0	2	2	5	11	12
	82140	10022	207	1.02	4	6	0	3	0	5	4	13
	82141	10417	181	1.02	9	14	2	3	1	3	11	20
	82142	9739	229	1.02	2	10	0	3	1	7	3	19
	82143	10602	0	1.00	13	8	0	3	0	3	13	14
	82144	10119	0	1.00	2	15	0	6	0	3	2	24
	82145	10059	90	1.01	13	13	0	0	1	6	14	19
	82146	9074	734	1.08	5	6	2	0	0	2	6	9
	82147	9249	881	1.10	7	12	0	0	0	4	7	16
	82149	10547	237	1.02	2	12	2	1	1	1	5	14
	82150	9578	171	1.02	6	4	0	0	0	0	6	4
	82152	9704	0	1.00	8	13	2	1	2	3	12	18
	82153	9206	0	1.00	11	0	2	3	0	4	12	7
	Subtotal				671	993	57	217	78	285	806	1495

(a) Abbreviations are M = male and F = female

(b) Includes jacks

Table 38 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1986. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 35) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1980	21657	52900	358985	7.79	0	0	0	0	0	9	0	9
	21943	51220	330509	7.45	0	0	0	0	0	8	0	8
	21950	52001	291163	6.60	0	13	0	0	0	0	0	13
	Subtotal				0	13	0	0	0	17	0	29
Total					981	1134	269	315	928	723	2178	2172

Table 39. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 36) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1985	23555	20096	274640	14.67	0	0	0	0	23	0	23	0
	Subtotal				0	0	0	0	23	0	23	0
1984	23322	24584	316880	13.89	0	0	75	23	44	0	119	23
	23323	24538	316288	13.89	35	0	38	0	132	15	205	15
	23324	24527	316145	13.89	0	0	0	0	88	0	88	0
	23325	26157	305357	12.67	64	0	205	0	0	0	269	0
	23326	24937	291114	12.67	32	0	68	0	0	0	100	0
	23327	23714	276837	12.67	64	0	68	0	0	0	133	0
	23328	24471	304874	13.46	34	0	0	0	0	0	34	0
	23329	29676	369721	13.46	0	0	182	0	0	0	182	0
	23330	24459	304724	13.46	0	0	36	0	0	0	36	0
	82351	9657	508	1.05	3	0	3	0	0	0	6	0
	82353	10039	528	1.05	3	0	9	0	0	0	11	0
	82355	10073	586	1.06	0	0	9	0	0	0	9	0
	82356	9940	579	1.06	5	0	11	0	0	0	17	0
	82357	10322	471	1.05	3	0	0	0	0	0	3	0
	82358	10132	461	1.05	0	0	6	0	0	0	6	0
	82359	10009	455	1.05	0	0	3	0	0	0	3	0
	82360	10577	310	1.03	0	0	8	0	0	0	8	0
	82361	10342	303	1.03	0	0	3	0	0	0	3	0
	Subtotal				242	0	724	23	264	15	1231	38
1983	22631	49499	619827	13.52	307	73	183	158	278	72	768	303
	22632	50069	586484	12.71	289	91	137	0	363	190	789	281
	82220	11649	58	1.00	0	0	0	0	2	0	2	0

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 39 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 36) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82221	11621	3460	1.30	3	0	4	2	0	0	7	2
	82257	10814	802	1.07	5	0	0	2	3	0	9	2
	82258	10878	810	1.07	3	0	0	0	2	0	4	0
	82259	10834	806	1.07	0	0	12	0	0	0	12	0
	82260	12173	149	1.01	0	0	3	2	2	1	4	3
	82261	1163	142	1.12	3	0	3	4	2	1	8	5
	82262	11465	140	1.01	10	0	0	2	5	0	15	2
	82263	11833	48	1.00	0	0	0	0	0	1	0	1
	82301	11641	47	1.00	3	0	0	0	0	0	3	0
	82302	11617	47	1.00	3	4	0	0	0	0	3	4
	Subtotal				626	168	341	169	656	265	1623	602
1982	22518	36234	268167	8.40	148	75	136	126	106	143	391	345
	22519	35375	247913	8.01	81	72	22	27	101	196	204	295
	82046	9763	196	1.02	8	4	3	9	3	8	14	20
	82047	9846	197	1.02	0	4	0	5	2	5	2	14
	82048	10159	204	1.02	0	4	3	7	3	4	6	15
	82049	10637	213	1.02	5	9	6	5	10	9	20	23
	82050	9803	196	1.02	8	7	11	2	5	5	24	14
	82051	9880	198	1.02	8	13	0	12	5	11	13	36
	82052	10221	205	1.02	0	5	0	7	8	10	8	22
	82053	9794	196	1.02	10	2	3	2	6	7	20	10
	82054	9812	196	1.02	3	7	3	3	10	10	15	21
	82055	10494	179	1.02	3	4	0	7	6	2	9	13
	82056	9855	168	1.02	3	5	3	8	3	12	9	26
	82057	9935	169	1.02	3	4	3	7	3	8	9	18

(a) Abreviations are M = male and F = female
(b) Includes jacks

Table 39 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 36) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82058	10014	170	1.02	5	7	3	2	2	10	9	19
	82059	9870	168	1.02	5	4	3	7	6	4	14	15
	82060	9932	169	1.02	3	4	5	2	2	9	10	14
	82061	9831	167	1.02	3	5	3	5	0	11	5	21
	82062	9882	168	1.02	3	4	3	7	6	4	12	15
	82063	10160	173	1.02	5	2	0	7	0	8	5	16
	82101	9915	112	1.01	0	5	0	8	2	4	2	18
	82102	10176	115	1.01	3	4	5	5	2	5	10	14
	82103	9884	112	1.01	3	2	0	7	11	6	14	15
	82104	9928	113	1.01	3	7	3	5	8	0	13	12
	82105	9946	113	1.01	8	4	5	3	5	8	18	15
	82106	9944	113	1.01	10	4	3	3	2	6	15	13
	82107	9937	113	1.01	10	0	0	0	5	3	15	3
	82108	9922	112	1.01	8	5	0	3	3	9	11	17
	82109	9954	113	1.01	5	4	3	10	0	6	8	20
	82110	9842	240	1.02	3	6	3	3	2	2	7	11
	82111	9822	240	1.02	3	0	0	3	0	4	3	8
	82112	9883	241	1.02	3	4	0	2	2	4	4	10
	82113	9872	241	1.02	5	6	0	3	3	3	8	12
	82114	9812	240	1.02	8	9	0	2	3	2	11	13
	82115	9875	241	1.02	0	7	0	5	8	2	8	15
	82148	10547	237	1.02	0	2	0	2	2	5	2	9
	82151	9816	240	1.02	3	2	3	3	2	4	7	10
	82154	10021	245	1.02	5	7	0	5	3	2	8	15
	82207	11413	585	1.05	3	2	0	4	2	6	4	11
	82208	11039	582	1.05	5	2	3	0	10	4	18	6

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 39 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 36) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82209	11021	581	1.05	5	0	3	2	3	4	11	6
	82210	11413	233	1.02	5	2	0	2	2	5	7	9
	82211	11666	239	1.02	0	7	3	5	2	5	4	18
	82212	11499	235	1.02	3	5	3	2	3	0	9	7
	82214	11178	467	1.04	5	0	0	2	0	0	5	2
	82215	11107	463	1.04	3	0	0	0	0	1	3	1
	82216	11499	155	1.01	0	0	0	0	0	1	0	1
	82217	11501	155	1.01	0	0	0	0	2	0	2	0
	82218	11588	156	1.01	0	0	0	0	0	3	0	3
	82219	11168	466	1.04	0	2	0	2	2	0	2	4
	Subtotal				407	338	243	347	375	585	1025	1270
1981	22303	49802	130371	3.62	18	65	0	12	0	8	18	85
	22304	49953	208280	5.17	0	65	0	52	8	11	8	128
	82119	6740	470	1.07	3	0	0	0	0	0	3	0
	82120	9215	212	1.02	0	4	0	2	0	2	0	8
	82121	8782	220	1.03	5	0	0	2	2	0	7	2
	82122	9761	256	1.03	0	0	0	2	0	0	0	2
	82123	10070	178	1.02	0	2	3	0	0	0	3	2
	82124	10108	164	1.02	0	5	0	2	0	2	0	9
	82125	9539	867	1.09	3	4	0	0	0	1	3	5
	82126	9754	667	1.07	0	8	0	0	2	1	2	9
	82127	9622	675	1.07	0	0	3	2	0	0	3	2
	82128	9434	708	1.08	3	4	0	0	0	2	3	6
	82129	9590	581	1.06	0	4	0	0	0	2	0	6
	82130	9072	865	1.10	6	4	0	2	0	0	6	6

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 39 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 36) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82131	10184	186	1.02	0	5	0	0	2	0	2	5
	82132	10302	160	1.02	3	0	0	2	0	0	3	2
	82133	9776	213	1.02	0	6	0	0	0	2	0	8
	82134	10205	100	1.01	0	4	0	2	0	0	0	5
	82135	10394	106	1.01	0	5	0	2	2	1	2	8
	82136	10169	0	1.00	3	4	0	2	0	1	3	6
	82137	9478	653	1.07	5	2	0	2	0	0	5	4
	82138	9763	610	1.06	0	4	0	0	0	1	0	5
	82139	9400	559	1.06	5	0	0	4	0	0	5	4
	82140	10022	207	1.02	0	0	0	0	0	1	0	1
	82141	10417	181	1.02	0	2	0	2	0	0	0	4
	82142	9739	229	1.02	3	0	0	0	2	0	4	0
	82143	10602	0	1.00	3	4	0	2	0	1	3	6
	82144	10119	0	1.00	0	4	3	0	0	1	3	5
	82145	10059	90	1.01	3	4	0	0	0	1	3	5
	82146	9074	734	1.08	0	4	0	2	0	2	0	8
	82147	9249	881	1.10	0	0	0	0	0	2	0	2
	82149	9578	171	1.02	0	4	0	0	0	2	0	6
	82150	9578	171	1.02	0	0	0	0	0	1	0	1
	Subtotal				61	214	8	91	16	48	85	353
Total					1336	720	1316	630	1334	913	3986	2263

Table 40. Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1988. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 37) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1986	24158	19980	299513	15.99	0	0	0	0	17	0	17	0
	Subtotal				0	0	0	0	17	0	17	0
1985	23522	19954	318335	16.95	0	0	54	0	18	0	72	0
	23523	19975	320079	17.02	0	0	0	0	18	0	18	0
	23524	20217	321701	16.91	0	0	0	0	36	0	36	0
	23525	20038	273848	14.67	0	0	46	0	79	0	125	0
	23554	20110	274832	14.67	0	0	0	0	16	0	16	0
	23555	20096	274640	14.67	0	0	0	0	31	0	31	0
	23556	20145	844309	42.91	0	0	0	0	46	0	46	0
	23645	24843	98507	4.97	17	0	0	0	11	0	27	0
	Subtotal				17	0	100	0	255	0	372	0
1984	23322	24584	316880	13.89	46	84	132	172	104	57	282	313
	23323	24538	316288	13.89	0	42	88	57	164	114	252	214
	23324	24527	316145	13.89	93	42	176	115	74	114	343	271
	23325	26157	305357	12.67	170	0	200	210	285	248	655	457
	23326	24937	291114	12.67	127	191	200	210	285	169	613	570
	23327	23714	276837	12.67	42	38	280	157	367	287	690	482
	23328	24471	304874	13.46	45	162	298	223	260	83	602	468
	23329	29676	369721	13.46	45	81	383	139	389	152	817	373
	23330	24459	304724	13.46	0	41	383	56	274	166	657	262
	82351	9657	508	1.05	4	0	7	0	3	0	14	0
	82352	10317	543	1.05	0	3	7	4	6	2	12	10
	82353	10039	528	1.05	7	3	10	0	6	1	23	4
	82354	10228	595	1.06	7	0	3	2	3	1	14	3

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 40 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 37) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
	82355	10073	586	1.06	7	3	7	7	3	1	17	11
	82356	9940	579	1.06	7	0	10	0	1	2	18	2
	82357	10332	471	1.05	7	0	10	11	2	2	19	13
	82358	10132	461	1.05	7	3	10	4	3	2	20	10
	82359	10009	455	1.05	0	3	7	4	3	3	10	11
	82360	10577	310	1.03	3	6	3	0	2	2	9	8
	82361	10342	303	1.03	0	0	0	0	1	3	1	3
	82362	10281	302	1.03	0	6	0	4	2	0	2	10
	Subtotal				618	709	2213	1376	2240	1411	5071	3497
1983	22631	49499	619827	13.52	271	204	256	224	58	181	586	608
	22632	50069	586484	12.71	340	307	161	342	68	196	569	845
	82213	11666	41	1.00	0	0	0	0	0	1	0	1
	82220	11649	59	1.01	3	0	3	0	0	0	7	0
	82221	11621	58	1.00	3	0	0	0	0	0	3	0
	82257	10814	802	1.07	0	6	3	7	3	2	7	15
	82258	10878	810	1.07	0	3	3	4	1	0	5	8
	82259	10834	806	1.07	0	0	0	4	1	2	1	7
	82260	12173	149	1.01	7	6	3	0	2	0	12	6
	82261	11633	142	1.01	7	6	0	0	0	0	7	6
	82262	11465	140	1.01	7	9	3	2	0	1	10	12
	82263	11833	48	1.00	0	0	0	2	0	0	0	2
	82301	11641	47	1.00	0	3	0	2	0	0	0	5
	82302	11617	47	1.00	0	3	0	4	0	0	0	7
	Subtotal				639	548	434	592	134	383	1206	1523

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 40 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 37) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1982	22518	36234	268167	8.40	0	0	0	0	0	17	0	17
	22519	35375	247913	8.01	0	0	0	0	0	8	0	8
	82046	9763	196	1.02	0	0	0	0	0	4	0	4
	82048	10159	204	1.02	0	3	0	0	0	0	0	3
	82049	10637	213	1.02	0	9	0	2	0	0	0	11
	82052	10221	205	1.02	0	3	0	0	0	0	0	3
	82054	9812	196	1.02	0	3	0	2	0	0	0	5
	82055	10494	179	1.02	0	0	0	0	0	2	0	2
	82056	9855	168	1.02	0	0	0	0	0	2	0	2
	82057	9935	169	1.02	0	0	0	0	0	1	0	1
	82058	10014	170	1.02	0	0	0	2	0	1	0	3
	82059	9870	168	1.02	0	0	0	2	0	2	0	4
	82061	9831	167	1.02	0	0	0	2	0	0	0	2
	82062	9882	168	1.02	0	3	0	4	0	2	0	9
	82063	10160	173	1.02	0	0	0	0	0	1	0	1
	82102	10176	115	1.01	0	3	0	6	0	0	0	9
	82104	9928	113	1.01	0	3	0	0	0	1	0	4
	82105	9946	113	1.01	0	0	0	4	0	0	0	4
	82106	9944	113	1.01	0	0	0	0	0	1	0	1
	82107	9937	113	1.01	3	0	0	0	0	1	3	1
	82111	9822	240	1.02	0	3	0	2	1	0	1	5
	82113	9872	241	1.02	3	0	0	0	0	0	3	0
	82114	9812	240	1.02	0	0	0	2	0	0	0	2
	82154	10021	245	1.02	0	3	0	0	0	0	0	3
	82207	11096	585	1.05	0	0	0	2	0	0	0	2
	82208	11039	582	1.05	0	3	0	0	1	0	1	3

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 40 (cont). Estimates of total escapement of hatchery reared chinook salmon to the Campbell River, Quinsam River, and Quinsam Hatchery by tag code, 1987. The expansion factor is used to expand the estimated number of adipose clipped chinook in the escapement (from Table 37) to account for unmarked hatchery releases and hence to derive hatchery contributions to escapement. Expansion factor = (marked + unmarked releases) / marked releases.

Brood year	CWT code	Release numbers		Expansion factor	Expanded hatchery contribution (a)							
					Campbell River		Quinsam River		Quinsam Hatchery		Total	
		Marked	Unmarked		M (b)	F	M	F	M	F	M	F
1982	82209	11021	581	1.05	0	0	0	2	0	0	0	2
	82210	11413	233	1.02	0	3	0	0	0	0	0	3
	82211	11666	239	1.02	0	0	0	2	0	0	0	2
	Subtotal				7	40	0	36	2	44	9	120
1981	82123	10070	178	1.02	0	0	3	0	0	0	3	0
	82136	10169	0	1.00	0	0	3	0	0	0	3	0
	82144	10119	0	1.00	0	0	3	0	0	0	3	0
	82149	9578	171	1.02	0	3	0	0	0	0	0	3
	Subtotal				0	3	10	0	0	0	10	3
Total					1281	1300	2757	2004	2648	1838	6686	5142

(a) Abreviations are M = male and F = female

(b) Includes jacks

Table 41. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1986. Petersen estimates of escapement for Campbell and Quinsam rivers were derived using the in situ carcass tagging method.

River	Age	Estimated escapement (a)		Hatchery contribution (b)		% Hatchery contribution	
		Male (c)	Female	Male	Female	Male	Female
Campbell River							
	2	4	0	0	0	0.0	0.0
	3	101	0	57	0	56.4	0.0
	4	518	222	253	128	48.8	57.7
	5 (d)	1301	2000	671	993	51.6	49.7
	6	4	0	0	13	0.0	100.0 (e)
	Total	1928	2222	981	1134	50.9	51.0
Quinsam River							
	2	10	0	0	0	0.0	0.0
	3	53	0	43	0	81.1	0.0
	4	444	160	169	98	38.1	61.3
	5 (d)	172	424	57	217	33.1	51.2
	6	0	0	0	0	0.0	0.0
	Total	679	584	269	315	39.6	53.9
Quinsam Hatchery							
	2	84	0	0	0	0.0	0.0
	3	305	10	339	0	100.0 (e)	0.0
	4	605	484	511	421	84.5	87.0
	5	92	299	78	285	84.8	95.3
	6	0	6	0	17	0.0	100.0 (e)
	Total	1086	799	928	723	85.5	90.5
System Total							
	2	98	0	0	0	0.0	0.0
	3	459	10	439	0	95.6	0.0
	4	1567	866	933	647	59.5	74.7
	5	1565	2723	806	1495	51.5	54.9
	6	4	6	0	30	0.0	100.0 (e)
	Total	3693	3605	2178	2172	59.0	60.2

(a) From Table 26
(b) From Table 38
(c) Includes jacks
(d) Age 5.1 plus 5.2
(e) Hatchery contribution was calculated to be greater than the estimated escapement, therefore the hatchery contribution was assumed to be 100% of the escapement.

Table 42. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1987.

River	Age	Estimated escapement (a) Male (c)	Female	Hatchery contribution (b) Male	Female	% Hatchery contribution Male	Female
Campbell River							
	2	0	0	0	0	0.0	0.0
	3	138	0	242	0	100.0 (e)	0.0
	4	427	175	626	168	100.0 (e)	96.0
	5	736	728	407	338	55.3	46.4
	6 (e)	157	383	61	214	38.9	55.9
	Total	1458	1286	1336	720	91.6	56.0
Quinsam River							
	2	0	0	0	0	0.0	0.0
	3	569	8	724	23	100.0 (e)	100.0 (e)
	4	394	216	341	169	86.5	78.2
	5	305	560	243	347	79.7	62.0
	6 (e)	35	101	8	91	22.9	90.1
	Total	1303	885	1316	630	100.0 (e)	71.2
Quinsam Hatchery							
	2	16	0	23	0	100.0 (e)	0.0
	3	827	5	264	15	31.9	100.0 (e)
	4	523	143	656	265	100.0 (e)	100.0 (e)
	5	810	896	375	585	46.3	65.3
	6	48	95	16	48	33.3	50.5
	Total	2224	1139	1334	913	60.0	80.2
System Total							
	2	16	0	23	0	100.0 (e)	0.0
	3	1534	13	1230	38	80.2	100.0 (e)
	4	1344	534	1623	602	100.0 (e)	100.0 (e)
	5	1851	2184	1025	1270	55.4	58.2
	6	240	579	85	353	35.4	61.0
	Total	4985	3310	3986	2263	80.0	68.4

(a) From Table 27
(b) From Table 39
(c) Includes jacks
(d) Age 6.1 plus 6.2
(e) Hatchery contribution was calculated to be greater than the estimated escapement, therefore the hatchery contribution was assumed to be 100% of the escapement.

Table 43. Estimated hatchery contribution to the Campbell River, Quinsam River, and Quinsam Hatchery chinook salmon escapement, 1988.

River	Age	Estimated escapement (a) Male (c)	Estimated escapement (a) Female	Hatchery contribution (b) Male	Hatchery contribution (b) Female	% Hatchery contribution Male	% Hatchery contribution Female
Campbell River							
	2	0	0	0	0	0.0	0.0
	3	51	0	17	0	33.3	0.0
	4	1072	498	618	709	57.6	100.0 (d)
	5	502	861	639	548	100.0 (d)	63.6
	6	20	143	7	40	35.0	28.0
	7	0	6	0	3	0.0	50.0
	Total	1645	1508	1281	1300	77.9	86.2
Quinsam River							
	2	0	0	0	0	0.0	0.0
	3	71	0	100	0	100.0 (d)	0.0
	4	2705	1226	2213	1376	81.8	100.0 (d)
	5	403	706	434	592	100.0 (d)	83.9
	6	0	150	0	36	0.0	24.0
	7	42	8	10	0	23.8	0.0
	Total	3221	2090	2757	2004	85.6	95.9
Quinsam Hatchery							
	2	59	0	17	0	28.8	0.0
	3	200	0	255	0	100.0 (d)	0.0
	4	2688	1601	2240	1411	83.3	88.1
	5	163	432	134	383	82.2	88.7
	6	16	127	2	44	12.5	34.6
	Total	3126	2160	2648	1838	84.7	85.1
System Total							
	2	59	0	17	0	28.8	0.0
	3	322	0	372	0	100.0 (d)	0.0
	4	6465	3325	5071	3496	78.4	100.0 (d)
	5	1068	1999	1207	1523	100.0 (d)	76.2
	6	36	420	9	120	25.0	28.6
	7	42	14	10	3	23.8	21.4
	Total	7992	5758	6686	5142	83.7	89.3

(a) From Table 28
(b) From Table 40
(c) Includes jacks
(d) Hatchery contribution was calculated to be greater than the estimated escapement, therefore the hatchery contribution was assumed to be 100% of the escapement.

Table 44. Summary of release and recovery of live-tagged chinook salmon carcasses in Campbell and Quinsam rivers, 1988.

River	Area (a)	Tagging period	Number released/recovered			
			Males	Females	Jacks	Total
Releases						
Campbell	Bob's Boathouse (estuary)	Sep 1-Sep 15	185	200	29	414
Recoveries						
Campbell	A1	Oct 18-Oct 28	1	2	0	3
	B1	Oct 18-Nov 21	9	8	1	18
	Total		10	10	1	21
Quinsam	B2	Oct 31-Nov 17	1	5	0	6
	C2	Oct 17-Nov 24	7	14	0	21
	D2	Oct 17-Nov 14	8	2	3	13
	Total		16	21	3	40
Hatchery	Total	Sep 31-Nov 4	61	64	13	138
Total for system			87	95	17	199

(a) See Fig. 1 for locations

Table 45. Summary of live tagging and recovery of chinook salmon in Campbell and Quinsam rivers and Quinsam Hatchery and Petersen estimates of escapement using three different sources of recovery information, 1988. Confidence limits are from fiducial limits for the Poisson distribution using Pearson's formulae when R is greater than 50 (Ricker 1975, p. 343).

Item	Males	Females	Jacks	Total
Number tagged in estuary (live)	185	200	29	414
A. Quinsam Hatchery live recovery				
Number recovered (a)	2455	2160	671	5286
Number of tagged fish recovered (b)	61	64	13	138
Petersen estimate	7368	6682	1440	15490
Upper 95% CL	9421	8497	2552	20471
Lower 95% CL	5757	5251	865	11873
B. Campbell and Quinsam rivers dead recovery				
Number recovered (c)	1561	1658	280	3499
Number of tagged fish recovered	26	31	4	61
Petersen estimate	10760	10421	1686	22867
Upper 95% CL	16141	15157	4215	35513
Lower 95% CL	7450	7410	753	15612
C. Quinsam Hatchery live and both rivers dead recovery combined				
Number recovered	4016	3818	951	8785
Number of tagged fish recovered	87	95	17	199
Petersen estimate	8490	7996	1587	18073
Upper 95% CL	10445	9752	2620	22817
Lower 95% CL	6899	6554	1013	14465
Tag rate for live plus dead recovery (%)	2.2	2.5	1.8	2.1
Tag recovery rate for live plus dead recovery (%)	47.0	47.5	58.6	51.0
Tag loss (%):	1.1	5.3	0.0	3.0

(a) From Table 16
(b) Includes all fish with secondary tags (i. e. opercular hole punches)
(c) From Appendix D7 and Appendix D8

APPENDIX A

Hatchery broodstock carcass release and recovery data
for Campbell and Quinsam rivers, 1986

Appendix A1. Release of tagged chinook salmon carcasses in Campbell River, 1986.

Date	Release site (a)	Released			
		Males	Females	Jacks	Total
Oct-19	Upper channel	2	3	0	5
	Lower channel	3	2	0	5
	Above pumphouse	6	3	1	10
	Logging bridge	8	6	1	15
	Highway bridge	9	5	1	15
	Total	28	19	3	50
Oct-26	Upper channel	3	2	0	5
	Lower channel	2	3	0	5
	Above pumphouse	5	5	0	10
	Logging bridge	6	9	0	15
	Highway bridge	9	5	1	15
	Total	25	24	1	50
Nov-03	Upper channel	2	2	1	5
	Lower channel	3	1	1	5
	Above pumphouse	5	3	2	10
	Logging bridge	7	5	3	15
	Highway bridge	5	9	1	15
	Total	22	20	8	50
Nov-09	Upper channel	3	2	0	5
	Lower channel	2	2	1	5
	Above pumphouse	4	4	2	10
	Logging bridge	3	10	2	15
	Highway bridge	1	11	3	15
	Total	13	29	8	50

(a) See Fig. 1 for location of release sites

Appendix A2. Release of tagged chinook salmon carcasses in Quinsam River, 1986.

Date	Release site (a)	Released			
		Males	Females	Jacks	Total
Oct-20	Fence	5	4	1	10
	Leaf trap	4	4	2	10
	Dyke	2	5	3	10
	Cold Creek	4	4	0	8
	Alder run	2	3	2	7
	Argonaut bridge	1	1	1	3
	Campsite	2	0	0	2
	Total	20	21	9	50
Oct-27	Fence	4	6	0	10
	Leaf trap	3	7	0	10
	Dyke	4	6	0	10
	Cold Creek	4	4	0	8
	Alder run	3	4	0	7
	Argonaut bridge	1	2	0	3
	Campsite	0	1	1	2
	Total	19	30	1	50
Nov-03	Fence	5	4	1	10
	Leaf trap	4	4	2	10
	Dyke	3	5	2	10
	Cold Creek	4	3	1	8
	Alder run	3	3	1	7
	Argonaut bridge	2	1	0	3
	Campsite	1	0	1	2
	Total	22	20	8	50
Nov-10	Fence	4	6	0	10
	Leaf trap	4	6	0	10
	Dyke	5	4	1	10
	Cold Creek	3	5	0	8
	Alder run	2	4	1	7
	Argonaut bridge	1	2	0	3
	Campsite	0	2	0	2
	Total	19	29	2	50

(a) See Fig. 1 for location of release sites

Appendix A3. Recovery of tagged chinook salmon carcasses in Campbell River, 1986.

Date	Recovery area (a)	Number recovered (b) Oct. 19 release				Number recovered Oct. 26 release				Number recovered Nov. 3 release				Number recovered Nov. 9 release			
		M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-20	1A	0	1	0	1												
Oct-21	1A	4	1	1	6												
	1B	2	3	0	5												
Oct-22	1B	2	3	0	5												
Oct-23	1B	0	3	0	3												
Oct-24	1A	1	2	0	3												
Oct-27	1A	2	0	0	2	2	2	0	4								
Oct-28	1A					0	4	0	4								
	1B	0	0	2	0	2	5	0	7								
Oct-29	1B					3	0	0	3								
Oct-30	1A					0	1	0	1								
	1B					0	1	0	1								
Oct-31	1B					2	1	1	4								
Nov-01	1B					0	2	0	2								
Nov-04	1A									5	6	0	11				
	1B					1	0	0	1	0	4	0	4				
Nov-06	1B									1	2	1	4				
Nov-07	1B					0	1	0	1	2	1	0	3				
Nov-11	1A													2	5	1	8
	1B									0	1	1	2	0	7	0	7
Nov-13	1A													1	1	0	2
Nov-14	1A									0	0	1	1				
Nov-18	1B													0	1	0	1
Total recovered		11	13	3	25	10	17	1	28	8	14	3	25	3	14	1	18
Tags applied		28	19	3	50	25	24	1	50	22	20	8	50	13	29	8	50

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack, T = total

Appendix A4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1986.

Date	Recovery area (a)	Number recovered (b) Oct. 20 release				Number recovered Oct. 27 release				Number recovered Nov. 3 release				Number recovered Nov. 10 release			
		M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-21	2B	9	9	2	20												
	2C	5	5	0	10												
	2D	0	1	1	2												
Oct-22	2D	0	0	1	1												
Oct-23	2B	1	0	0	1												
Oct-28	2B					7	9	0	16								
	2C	1	0	0	1	1	7	0	8								
	2D					1	1	0	2								
Oct-29	2D					0	2	0	2								
Oct-30	2B					0	1	0	1								
	2C					1	1	1	3								
Nov-04	2B									5	9	3	17				
	2C					3	0	0	3	5	6	1	12				
Nov-05	2D									1	0	1	2				
Nov-06	2B									2	0	0	2				
	2C									1	2	0	3				
Nov-07	2D									0	1	0	1				
Nov-11	2B									0	1	0	1	9	7	0	16
	2C													4	7	2	13
Nov-12	2D													0	2	0	2
Nov-13	2B													0	3	0	3
	2C					0	1	0	1								
Nov-17	2D													1	0	0	1
Total recovered		16	15	4	35	13	22	1	36	14	19	5	38	14	19	2	35
Tags applied		20	21	9	50	19	30	1	50	22	20	8	50	19	29	2	50

(a) See Fig. 1 for location of recovery areas

(b) Abreviaitions are M = male, F = female, J = jack, T = total

Appendix A5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1986. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-16	12		0	3		0	0		0	15		0
Oct-19	0	28	0	0	19	0	0	3	0	0	50	0
Oct-20	27		0	13		1	2		0	42		1
Oct-21	51		6	39		4	1		1	91		11
Oct-22	36		2	31		3	1		0	68		5
Oct-23	50		0	40		3	4		0	94		3
Oct-24	53		1	40		2	1		0	94		3
Oct-26	0	25	0	0	24	0	0	1	0	0	50	0
Oct-27	58		4	54		2	0		0	112		6
Oct-28	27		2	35		9	1		2	63		13
Oct-29	121		3	128		0	7		0	256		3
Oct-30	73		0	117		2	6		0	196		2
Oct-31	88		2	111		1	1		1	200		4
Nov-01	89		0	134		2	3		0	226		2
Nov-03	38	22	0	52	20	0	4	8	0	94	50	0
Nov-04	79		6	142		10	5		0	226		1[illegible]
Nov-05	15		0	16		0	1		0	32		0
Nov-06	56		1	74		2	4		1	134		4
Nov-07	15		2	52		2	0		0	67		4
Nov-09	0	13	0	0	29	0	0	8	0	0	50	0
Nov-10	20		0	30		0	3		0	53		0
Nov-11	16		2	63		13	1		2	80		17
Nov-12	18		0	23		0	0		0	41		0
Nov-13	16		1	32		1	0		0	48		2
Nov-14	19		0	44		0	0		1	63		1
Nov-17	5		0	17		0	0		0	22		0
Nov-18	3		0	12		1	0		0	15		1
Nov-20	11		0	22		0	2		0	35		0
Nov-21	1		0	11		0	0		0	12		0
Totals	997	88	32	1335	92	58	47	20	8	2379	200	98
Totals for MR	985	88	32	1332	92	58	47	20	8	2364	200	98

Appendix A6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1986. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-17	17		0	26		0	0		0	43		0
Oct-20	0	20	0	0	21	0	0	9	0	0	50	0
Oct-21	22		14	10		15	3		3	35		32
Oct-22	19		0	7		0	0		1	26		1
Oct-23	18		1	9		0	3		0	30		1
Oct-24	2		0	4		0	0		0	6		0
Oct-27	0	19	0	0	30	0	0	1	0	0	50	0
Oct-28	50		10	35		17	3		0	88		27
Oct-29	24		0	18		2	0		0	42		2
Oct-30	24		1	15		2	1		1	40		4
Nov-03	0	22	0	0	20	0	0	8	0	0	50	0
Nov-04	40		13	20		15	2		4	62		32
Nov-05	28		1	46		0	7		1	81		2
Nov-06	12		3	16		2	1		0	29		5
Nov-07	16		0	18		1	3		0	37		1
Nov-10	0	19	0	0	29	0	0	2	0	0	50	0
Nov-11	25		13	49		15	5		2	79		30
Nov-12	16		0	36		2	5		0	57		2
Nov-13	7		0	11		4	4		0	22		4
Nov-14	2		0	16		0	0		0	18		0
Nov-17	6		1	26		0	3		0	35		1
Nov-18	0		0	0		0	0		0	0		0
Nov-19	3		0	3		0	2		0	8		0
Totals	331	80	57	365	100	75	42	20	12	738	200	144
Totals for MR	314	80	57	339	100	75	42	20	12	695	200	144

Appendix A7. Total dead recovery and adipose clip recovery of chinook salmon in Campbell River, 1986 (a).

Date	Area 1A								Area 1B							
	Total recovered (b)				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-16	3	1	0	4	0	0	0	0	9	2	0	11	3	0	0	3
Oct-20	4	4	0	8	1	0	0	1	23	9	2	34	6	0	0	6
Oct-21	18	12	1	31	5	1	1	7	33	27	0	60	10	10	0	20
Oct-22	2	3	0	5	1	1	0	2	34	28	1	63	11	8	0	19
Oct-23	4	4	0	8	0	2	0	2	46	36	4	86	15	11	0	26
Oct-24	8	5	0	13	1	3	0	4	45	35	1	81	12	10	0	22
Oct-27	36	34	0	70	14	11	0	25	22	20	0	42	7	8	0	15
Oct-28	3	11	0	14	0	0	0	0	24	24	1	49	4	0	0	4
Oct-29									121	128	7	256	28	34	0	62
Oct-30	17	34	2	53	4	7	0	11	56	83	4	143	21	14	0	35
Oct-31	1	2	0	3	0	0	0	0	87	109	1	197	23	25	0	48
Nov-01	11	17	0	28	1	6	0	7	78	117	3	198	24	27	1	52
Nov-03									38	52	4	94	12	13	0	25
Nov-04	33	42	1	76	10	15	0	25	46	100	4	150	10	24	0	34
Nov-05									15	16	1	32	5	3	0	8
Nov-06	8	22	1	31	2	6	0	8	48	52	3	103	7	9	0	16
Nov-07	0	6	0	6	0	1	0	1	15	46	0	61	4	14	0	18
Nov-10	7	13	1	21	1	1	0	2	13	17	2	32	4	1	1	6
Nov-11	2	11	1	14	0	1	0	1	14	52	0	66	5	13	0	18
Nov-12									18	23	0	41	4	6	0	10
Nov-13	5	27	0	32	3	4	0	7	11	5	0	16	3	1	0	4
Nov-14	1	5	0	6	0	1	0	1	18	39	0	57	5	16	0	21
Nov-17	3	10	0	13	1	3	0	4	2	7	0	9	1	4	0	5
Nov-18	2	2	0	4	1	0	0	1	1	10	0	11	0	6	0	6
Nov-20	1	1	0	2	0	0	0	0	10	21	2	33	4	10	1	15
Nov-21	1	2	0	3	0	0	0	0	0	9	0	9	0	1	0	1
Total	170	268	7	445	45	63	1	109	827	1067	40	1934	228	268	3	499

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack, T = total

Appendix A8. Total dead recovery and adipose clip recovery of chinook salmon in Quinsam River, 1986 (a).

Date	Area 2B								Area 2C								Area 2D							
	Total recovered				Adipose clipped recovered				Total recovered				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-17	3	9	0	12	1	2	0	3	9	13	0	22	0	2	0	2	5	4	0	9	1	3	0	4
Oct-21	6	6	0	12	1	0	0	1	12	4	3	19	3	0	0	3	4	0	0	4	1	0	0	1
Oct-22									3	2	0	5	0	0	0	0	16	5	0	21	7	1	0	8
Oct-23	8	2	1	11	0	1	0	1	6	6	1	13	5	2	0	7	4	1	1	6	2	0	0	2
Oct-24	2	4	0	6	1	2	0	3																
Oct-28	7	8	0	15	2	3	0	5	40	25	3	68	14	6	1	21	3	2	0	5	2	0	0	2
Oct-29																	24	18	0	42	4	8	0	12
Oct-30	6	1	0	7	2	0	0	2	18	14	1	33	5	3	0	8								
Nov-04	20	3	0	23	2	0	0	2	20	17	2	39	6	10	1	17								
Nov-05									5	14	2	21	0	4	0	4	23	32	5	60	10	13	1	24
Nov-06	3	3	0	6	1	0	0	1	9	13	1	23	2	7	0	9								
Nov-07									0	1	0	1	0	0	0	0	16	17	3	36	7	7	1	15
Nov-11	2	6	0	8	1	1	0	2	23	43	5	71	10	13	0	23								
Nov-12																	16	36	5	57	6	17	2	25
Nov-13	3	1	2	6	0	0	0	0	4	10	2	16	1	4	0	5								
Nov-14																	2	16	0	18	0	6	0	6
Nov-17	0	5	2	7	0	3	0	3	5	11	0	16	3	7	0	10	1	10	1	12	0	1	1	2
Nov-19	0	0	2	2	0	0	1	1	2	3	0	5	1	2	0	3	1	0	0	1	0	0	0	0
Total	60	48	7	115	11	12	1	24	156	176	20	352	50	60	2	112	115	141	15	271	40	56	5	101

(a) See Fig. 1 for location of release sites

(b) Abreviations are M = male, F = female, J = jack, T = total

APPENDIX B

In situ tagging and release and recovery data
for Campbell and Quinsam rivers, 1986

Appendix B1. Release of tagged chinook salmon carcasses in Campbell River, 1986. The carcasses were tagged in situ.

Date	Release area (a)	Released			
		Males	Females	Jacks	Total
Oct-16	1A	2	0	0	2
	1B	2	2	0	4
Oct-20	1A	1	4	0	5
	1B	7	3	0	10
Oct-21	1A	6	6	0	12
	1B	11	8	0	19
Oct-22	1A	0	1	0	1
	1B	8	10	0	18
Oct-23	1A	2	1	0	3
	1B	15	12	2	29
Oct-24	1A	3	1	0	4
	1B	15	12	1	28
Oct-27	1A	9	13	0	22
	1B	7	6	0	13
Oct-28	1A	0	7	0	7
	1B	8	13	0	21
Oct-29	1A	0	0	0	0
	1B	33	48	6	87
Oct-30	1A	8	10	2	20
	1B	13	37	3	53
Oct-31	1A	0	1	0	1
	1B	19	21	0	40
Nov-01	1A	3	2	0	5
	1B	13	22	1	36
Nov-03	1A	0	0	0	0
	1B	6	10	1	17
Nov-04	1A	4	7	1	12
	1B	7	21	0	28
Nov-05	1A	0	0	0	0
	1B	2	3	1	6
Nov-06	1A	0	4	1	5
	1B	8	12	0	20
Nov-07	1A	0	1	0	1
	1B	3	8	0	11
Nov-10	1A	1	3	1	5
	1B	2	4	0	6
Nov-11	1A	0	3	0	3
	1B	3	9	0	12
Nov-12	1A	0	0	0	0
	1B	1	6	0	7
Nov-13	1A	0	6	0	6
	1B	1	1	0	2
Nov-14	1A	0	1	0	1
	1B	2	7	0	9
Nov-17	1A	0	2	0	2
	1B	0	0	0	0
Nov-18	1A	0	0	0	0
	1B	1	1	0	2
	Total	226	349	20	595

(a) See Fig. 1 for location of release areas

Appendix B2. Release of tagged chinook salmon carcasses in Quinsam River, 1986. The carcasses were tagged in situ.

Date	Release area (a)	Released				Date	Release area	Released			
		Males	Females	Jacks	Total			Males	Females	Jacks	Total
Oct-17	2B	0	4	0	4	Nov-06	2B	0	1	0	1
	2C	2	7	0	9		2C	0	4	0	4
	2D	3	0	0	3		2D	0	0	0	0
Oct-21	2B	1	3	0	4	Nov-07	2B	0	0	0	0
	2C	2	2	3	7		2C	0	1	0	1
	2D	0	0	0	0		2D	2	4	1	7
Oct-22	2B	0	0	0	0	Nov-11	2B	0	0	0	0
	2C	1	1	0	2		2C	2	14	0	16
	2D	2	2	0	4		2D	0	0	0	0
Oct-23	2B	0	0	1	1	Nov-12	2B	0	0	0	0
	2C	0	3	0	3		2C	0	0	0	0
	2D	1	0	0	1		2D	3	9	0	12
Oct-24	2B	0	1	0	1	Nov-13	2B	1	0	0	1
	2C	0	0	0	0		2C	0	2	0	2
	2D	0	0	0	0		2D	0	0	0	0
Oct-28	2B	1	0	0	1	Nov-14	2B	0	0	0	0
	2C	5	7	0	12		2C	0	0	0	0
	2D	0	1	0	1		2D	1	5	0	6
Oct-29	2B	0	0	0	0	Nov-17	2B	0	0	0	0
	2C	0	0	0	0		2C	0	1	0	1
	2D	4	7	0	11		2D	0	3	0	3
Oct-30	2B	0	0	0	0	Nov-19	2B	0	0	0	0
	2C	1	4	1	6		2C	0	1	0	1
	2D	0	0	0	0		2D	0	0	0	0
Nov-04	2B	3	0	0	3						
	2C	1	2	0	3						
	2D	0	0	0	0		Total	42	102	8	152
Nov-05	2B	0	0	0	0						
	2C	1	3	0	4						
	2D	5	10	2	17						

(a) See Fig. 1 for location of release areas

Appendix B3. Recovery of tagged chinook salmon carcasses in Campbell River, 1986. The carcasses were tagged in situ.

Date	Recovery area(a)	Recovered			
		Males	Females	Jacks	Total
Oct-16	1A	2	0	0	2
	1B	2	2	0	4
Oct-20	1A	1	4	0	5
	1B	7	3	0	10
Oct-21	1A	6	6	0	12
	1B	11	8	0	19
Oct-22	1A	0	1	0	1
	1B	8	10	0	18
Oct-23	1A	2	1	0	3
	1B	15	12	2	29
Oct-24	1A	3	1	0	4
	1B	15	12	1	28
Oct-27	1A	9	13	0	22
	1B	7	6	0	13
Oct-28	1A	0	7	0	7
	1B	8	13	0	21
Oct-29	1A	0	0	0	0
	1B	33	48	6	87
Oct-30	1A	8	10	2	20
	1B	13	37	3	53
Oct-31	1A	0	1	0	1
	1B	19	21	0	40
Nov-01	1A	3	2	0	5
	1B	13	22	1	36
Nov-03	1A	0	0	0	0
	1B	6	10	1	17
Nov-04	1A	4	7	1	12
	1B	7	21	0	28
Nov-05	1A	0	0	0	0
	1B	2	3	1	6
Nov-06	1A	0	4	1	5
	1B	8	12	0	20
Nov-07	1A	0	1	0	1
	1B	3	8	0	11
Nov-10	1A	1	3	1	5
	1B	2	4	0	6
Nov-11	1A	0	3	0	3
	1B	3	9	0	12
Nov-12	1A	0	0	0	0
	1B	1	6	0	7
Nov-13	1A	0	6	0	6
	1B	1	1	0	2
Nov-14	1A	0	1	0	1
	1B	2	7	0	9
Nov-17	1A	0	2	0	2
	1B	0	0	0	0
Nov-18	1A	0	0	0	0
	1B	1	1	0	2
	Total	226	349	20	595

(a) See Fig. 1 for location of recovery areas

Appendix B4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1986. The carcasses were tagged in situ.

Date	Recovery area(a)	Recovered				Date	Recovery area(a)	Recovered			
		Males	Females	Jacks	Total			Males	Females	Jacks	Total
Oct-21	2B	1	0	0	1	Nov-05	2B	0	0	0	0
	2C	1	1	0	2		2C	1	0	0	1
	2D	0	0	0	0		2D	2	2	0	4
Oct-22	2B	0	0	0	0	Nov-06	2B	0	0	0	0
	2C	0	2	0	2		2C	1	2	0	3
	2D	1	0	0	1		2D	0	0	0	0
Oct-23	2B	0	0	0	0	Nov-07	2B	0	0	0	0
	2C	2	1	0	3		2C	0	0	0	0
	2D	0	3	0	3		2D	1	7	1	9
Oct-24	2B	0	0	0	0	Nov-11	2B	1	1	0	2
	2C	0	0	0	0		2C	2	5	0	7
	2D	0	1	0	1		2D	0	0	0	0
Oct-28	2B	1	1	0	2	Nov-12	2B	0	0	0	0
	2C	0	3	1	4		2C	0	0	0	0
	2D	0	1	0	1		2D	1	2	0	3
Oct-29	2B	0	0	0	0	Nov-13	2B	0	0	0	0
	2C	0	0	0	0		2C	0	7	0	7
	2D	1	1	0	2		2D	0	0	0	0
Oct-30	2B	0	0	0	0	Nov-14	2B	0	0	0	0
	2C	1	4	0	5		2C	0	0	0	0
	2D	0	0	0	0		2D	2	5	0	7
Nov-03	2B	1	0	0	1	Nov-17	2B	0	0	0	0
	2C	0	0	0	0		2C	2	2	0	4
	2D	0	0	0	0		2D	0	5	0	5
Nov-04	2B	0	0	0	0						
	2C	0	3	1	4						
	2D	0	0	0	0		Total	22	59	3	84

(a) See Fig. 4 for location of recovery areas

Appendix B5. Sequential mark-recapture data for chinook salmon carcasses tagged in situ in Campbell River, 1986. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR). Numbers in bold are incorrect and underestimate the true number of fish examined (could not be verified).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-16	12	4	0	3	2	0	0	0	0	15	6	0
Oct-20	27	8	0	13	7	0	2	0	0	42	15	0
Oct-21	51	17	1	39	14	3	1	0	0	91	31	4
Oct-22	36	8	2	31	11	3	1	0	0	68	19	5
Oct-23	50	17	3	40	13	2	4	2	1	94	32	6
Oct-24	53	18	13	40	13	15	1	1	0	94	32	28
Oct-27	58	16	7	54	19	5	0	0	0	112	35	12
Oct-28	27	8	10	35	20	3	1	0	0	63	28	13
Oct-29	121	33	9	128	48	8	7	6	0	256	87	17
Oct-30	73	21	14	117	47	42	6	5	1	196	73	57
Oct-31	88	19	17	111	22	24	1	0	2	200	41	43
Nov-01	89	16	12	134	24	24	3	1	1	226	41	37
Nov-03	38	6	4	52	10	8	4	1	0	94	17	12
Nov-04	79	11	12	142	28	15	5	1	0	226	40	27
Nov-05	15	2	0	16	3	0	1	1	1	32	6	1
Nov-06	56	8	4	74	16	11	4	1	0	134	25	15
Nov-07	15	3	5	52	9	10	1	0	1	67	12	16
Nov-10	20	3	1	30	7	8	3	1	0	53	11	9
Nov-11	16	3	2	63	12	7	1	0	0	80	15	9
Nov-12	18	1	0	23	6	4	0	0	0	41	7	4
Nov-13	16	1	1	32	7	4	1	0	1	48	8	6
Nov-14	19	2	3	44	8	7	0	0	0	63	10	10
Nov-17	5	0	0	17	2	3	0	0	0	22	2	3
Nov-18	3	1	0	12	1	1	0	0	0	15	2	1
Nov-20	11	0	1	22	0	1	2	0	0	35	0	2
Nov-21	1	0	0	11	0	1	0	0	0	12	0	1
Totals	997	226	121	1335	349	209	47	20	8	2379	595	338
Totals for MR	985	226	121	1332	349	209	39	20	8	2356	595	338

Appendix B6. Sequential mark-recapture data for chinook salmon carcasses tagged in situ in the Quinsam River, 1986. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-17	17	5	0	26	11	0	0	0	0	43	16	0
Oct-21	22	3	2	10	5	1	3	3	0	35	11	3
Oct-22	19	3	1	7	3	2	0	0	0	26	6	3
Oct-23	18	1	2	9	3	4	3	1	0	30	5	6
Oct-24	2	0	0	4	1	1	0	0	0	6	1	1
Oct-28	50	6	1	35	8	5	3	0	1	88	14	7
Oct-29	24	4	1	18	7	1	0	0	0	42	11	2
Oct-30	24	1	1	15	4	4	1	1	0	40	6	5
Nov-04	40	4	0	20	2	3	2	0	1	62	6	4
Nov-05	28	6	4	46	13	2	7	2	0	81	21	6
Nov-06	12	0	1	16	5	2	1	0	0	29	5	3
Nov-07	16	2	1	18	5	7	3	1	1	37	8	9
Nov-11	25	2	3	49	14	6	5	0	0	79	16	9
Nov-12	16	3	1	36	9	2	5	0	0	57	12	3
Nov-13	7	1	0	11	2	7	4	0	0	22	3	7
Nov-14	2	1	2	16	5	5	0	0	0	18	6	7
Nov-17	6	0	2	26	4	7	3	0	0	35	4	9
Nov-19	3	0	0	3	1	0	2	0	0	8	1	0
Totals	331	42	22	365	102	59	42	8	3	738	152	84
Totals for MR	314	42	22	339	102	59	39	8	3	692	152	84

APPENDIX C

Release and recovery data for Campbell and Quinsam rivers, 1987

Appendix C1. Release of tagged chinook salmon carcasses in Campbell River, 1987.

Date	Release area (a)	Released			
		Males	Females	Jacks	Total
Oct-19	1A	0	0	0	0
	1B	6	1	0	7
Oct-21	1A				
	1B	2	0	0	2
Oct-22	1A	0	3	0	3
	1B	1	1	1	3
Oct-23	1A	1	1	0	2
	1B	7	4	0	11
Oct-26	1A	2	1	1	4
	1B	3	0	0	3
Oct-27	1A	0	0	1	1
	1B	14	15	1	30
Oct-28	1A				
	1B	6	3	0	9
Oct-29	1A	4	6	0	10
	1B	3	5	1	9
Oct-30	1A	0	0	0	0
	1B	10	7	0	17
Nov-02	1A	8	6	0	14
	1B	1	5	0	6
Nov-03	1A	5	3	1	9
	1B	17	28	1	46
Nov-04	1A	0	0	0	0
	1B	41	35	3	79
Nov-05	1A	5	13	0	18
	1B	4	3	1	8
Nov-06	1A	2	6	0	8
	1B	13	14	0	27
Nov-07	1A				
	1B	9	12	4	25
Nov-09	1A	2	10	0	12
	1B	2	10	0	12
Nov-10	1A	3	3	0	6
	1B	11	22	1	34
Nov-12	1A	1	8	0	9
	1B	7	15	1	23
Nov-13	1A	3	5	0	8
	1B	9	20	3	32
Nov-17	1A	0	5	1	6
	1B	5	17	1	23
Nov-19	1A	2	1	0	3
	1B	1	4	0	5
	Total	210	292	22	524

(a) See Fig. 1 for location of release areas

Appendix C2. Release of tagged chinook salmon carcasses in Quinsam River, 1987.

Date	Release area (a)	Released			
		Males	Females	Jacks	Total
Oct-19	2B	0	0	0	0
	2C	0	0	0	0
	2D	0	0	1	1
Oct-21	2B	0	0	0	0
	2C	0	1	0	1
	2D	0	0	0	0
Oct-26	2B	0	1	0	1
	2C	0	7	1	8
	2D	0	3	0	3
Oct-29	2B	0	1	0	1
	2C	1	6	0	7
	2D	2	3	0	5
Nov-02	2B	1	2	3	6
	2C	3	13	2	18
	2D				
Nov-03	2B	0	0	0	0
	2C	4	17	4	25
	2D	0	2	2	4
Nov-05	2B	3	7	4	14
	2C	6	15	7	28
	2D	1	8	1	10
Nov-06	2B				
	2C				
	2D	2	7	1	10
Nov-09	2B	4	9	12	25
	2C	6	26	15	47
	2D	7	8	1	16
Nov-11	2B	2	3	6	11
	2C	3	9	8	20
	2D	6	9	1	16
Nov-12	2B				
	2C				
	2D	1	6	0	7
Nov-16	2B	3	2	5	10
	2C	7	12	10	29
	2D	8	8	2	18
Nov-19	2B	0	1	0	1
	2C	7	12	1	20
	2D	4	13	3	20
Nov-20	2B				
	2C	2	7	2	11
	2D	1	1	1	3
Nov-23	2B	0	1	0	1
	2C	3	3	1	7
	2D	0	5	0	5
	Total	87	228	94	409

(a) See Fig. 1 for location of release areas

Appendix C3. Recovery of tagged chinook salmon carcasses in Campbell River, 1987.

Date	Recovery area (a)	Recovered			
		Males	Females	Jacks	Total
Oct-23	1A	0	0	0	0
	1B	4	1	0	5
Oct-27	1A	0	0	0	0
	1B	1	0	0	1
Oct-28	1A				
	1B	4	2	2	8
Oct-29	1A	0	1	0	1
	1B	0	0	0	0
Oct-30	1A	1	1	0	2
	1B	0	0	0	0
Nov-02	1A	2	2	0	4
	1B	1	2	0	3
Nov-03	1A	1	1	0	2
	1B	3	7	0	10
Nov-04	1A	0	0	0	0
	1B	3	6	0	9
Nov-05	1A	5	6	0	11
	1B	4	11	0	15
Nov-06	1A	0	1	0	1
	1B	21	25	0	46
Nov-07	1A				
	1B	8	10	0	18
Nov-09	1A	4	8	0	12
	1B	0	1	1	2
Nov-10	1A	1	1	0	2
	1B	10	19	1	30
Nov-12	1A	1	4	0	5
	1B	2	4	0	6
Nov-13	1A	2	2	0	4
	1B	7	21	1	29
Nov-17	1A	5	7	0	12
	1B	6	17	0	23
Nov-19	1A	0	3	0	3
	1B	2	10	0	12
Nov-20	1A	0	1	0	1
	1B	3	7	0	10
Nov-24	1A				
	1B	1	2	0	3
	Total	102	183	5	290

(a) See Fig. 1 for location of recovery areas

Appendix C4. Recovery of tagged chinook salmon carcasses in Quinsam River, 1987.

Date	Recovery area (a)	Recovered			
		Males	Females	Jacks	Total
Oct-26	2B	1	0	0	1
	2C	0	0	0	0
	2D	0	0	0	0
Oct-29	2B	0	2	0	2
	2C	0	1	0	1
	2D	0	2	1	3
Nov-02	2B	0	1	0	1
	2C	1	4	0	5
	2D				
Nov-03	2B	0	0	0	0
	2C	0	2	0	2
	2D	1	2	0	3
Nov-05	2B	0	1	2	3
	2C	4	10	1	15
	2D	2	5	0	7
Nov-06	2B				
	2C				
	2D	0	10	2	12
Nov-09	2B	2	7	1	10
	2C	2	11	2	15
	2D	2	2	0	4
Nov-11	2B	1	3	3	7
	2C	5	11	7	23
	2D	3	12	1	16
Nov-12	2B				
	2C				
	2D	0	1	1	2
Nov-16	2B	1	2	4	7
	2C	0	7	3	10
	2D	4	7	0	11
Nov-19	2B	1	0	2	3
	2C	2	14	5	21
	2D	8	10	0	18
Nov-20	2B				
	2C	0	0	0	0
	2D	1	2	1	4
Nov-23	2B	0	0	0	0
	2C	4	4	0	8
	2D	1	4	0	5
Nov-26	2B				
	2C	1	4	0	5
	2D	0	5	0	5
Nov-30	2B				
	2C	0	1	0	1
	2D	0	0	0	0
	Total	46	147	36	229

(a) See Fig. 1 for location of recovery areas

Appendix C5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1987. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR). Numbers in bold are incorrect and underestimate the true number of fish examined (could not be verified).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-19	12	6	0	4	1	0	0	0	0	16	7	0
Oct-21	9	2	0	1	0	0	0	0	0	10	2	0
Oct-22	7	1	0	6	4	0	1	1	0	14	6	0
Oct-23	19	8	4	24	5	1	0	0	0	43	13	5
Oct-26	13	5	0	6	1	0	1	1	0	20	7	0
Oct-27	45	14	1	37	15	0	2	2	0	84	31	1
Oct-28	8	6	4	12	3	2	2	0	2	22	9	8
Oct-29	18	7	0	24	11	1	5	1	0	47	19	1
Oct-30	26	10	1	18	7	1	0	0	0	44	17	2
Nov-02	32	9	3	28	11	4	1	0	0	61	20	7
Nov-03	55	22	4	85	31	8	5	2	0	145	55	12
Nov-04	104	41	3	101	35	6	8	3	0	213	79	9
Nov-05	19	9	9	46	16	17	2	1	0	67	26	26
Nov-06	**35**	15	21	52	20	26	1	0	0	88	35	47
Nov-07	32	9	8	34	12	10	9	4	0	75	25	18
Nov-09	20	4	4	46	20	9	2	0	1	68	24	14
Nov-10	39	14	11	60	25	20	2	1	1	101	40	32
Nov-12	29	8	3	51	23	8	7	1	0	87	32	11
Nov-13	36	12	9	65	25	23	8	3	1	109	40	33
Nov-17	**15**	5	11	55	22	24	6	2	0	76	29	35
Nov-19	14	3	2	19	5	13	1	0	0	34	8	15
Nov-20	8	0	3	16	0	8	2	0	0	26	0	11
Nov-24	3	0	1	3	0	2	0	0	0	6	0	3
Nov-25	0	0	0	1	0	0	0	0	0	1	0	0
Nov-27	3	0	0	3	0	0	0	0	0	6	0	0
Totals	601	210	102	797	292	183	65	22	5	1463	524	290
Totals for MR	589	210	102	793	292	183	64	22	5	1446	524	290

Appendix C6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1987. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-19	0	0	0	1	0	0	2	1	0	3	1	0
Oct-21	0	0	0	3	1	0	0	0	0	3	1	0
Oct-26	4	0	1	25	11	0	2	1	0	31	12	1
Oct-29	9	3	0	25	10	5	6	0	1	40	13	6
Nov-02	10	4	1	50	15	5	20	5	0	80	24	6
Nov-03	15	4	1	48	19	4	19	6	0	82	29	5
Nov-05	31	10	6	73	30	16	47	12	3	151	52	25
Nov-06	8	2	0	23	7	10	7	1	2	38	10	12
Nov-09	44	17	6	80	43	20	95	28	3	219	88	29
Nov-11	32	11	9	52	21	26	47	15	11	131	47	46
Nov-12	8	1	0	13	6	1	1	0	1	22	7	2
Nov-16	36	18	5	60	22	16	52	17	7	148	57	28
Nov-19	23	11	11	59	26	24	20	4	7	102	41	42
Nov-20	7	3	1	24	8	2	10	3	1	41	14	4
Nov-23	7	3	5	22	9	8	5	1	0	34	13	13
Nov-26	9	0	1	21	0	9	6	0	0	36	0	10
Nov-30	5	0	0	9	0	1	1	0	0	15	0	1
Totals	248	87	47	588	228	147	340	94	36	1176	409	230
Totals for MR	235	87	47	584	228	147	338	94	36	1157	409	230

Appendix C7. Total dead recovery and adipose clip recovery in Campbell River, 1987(a).

Date	Area 1A								Area 1B							
	Total recovered (b)				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-19	0	0	0	0	0	0	0	0	12	4	0	16	2	0	0	2
Oct-21									9	1	0	10	5	1	0	6
Oct-22	3	4	0	7	0	0	0	0	4	2	1	7	2	0	0	2
Oct-23	4	3	0	7	1	2	0	3	15	21	0	36	6	8	0	14
Oct-26	1	3	1	5	0	0	0	0	12	3	0	15	3	2	0	5
Oct-27	3	2	0	5	1	1	0	2	42	35	2	79	13	7	0	20
Oct-28									8	12	2	22	2	2	0	4
Oct-29	11	14	0	25	2	2	0	4	7	10	5	22	1	1	1	3
Oct-30	0	0	0	0	0	0	0	0	26	18	0	44	6	4	0	10
Nov-02	20	17	0	37	4	5	0	9	12	11	1	24	7	4	0	11
Nov-03	11	13	2	26	3	5	0	8	44	72	3	119	7	19	0	26
Nov-04	0	0	0	0	0	0	0	0	104	101	8	213	23	30	1	54
Nov-05	14	34	1	49	3	9	0	12	5	12	1	18	0	4	0	4
Nov-06	6	11	0	17	0	0	0	0	29	41	1	71	4	13	0	17
Nov-07									32	34	9	75	12	11	2	25
Nov-09	10	23	1	34	3	5	1	9	10	23	1	34	3	6	0	9
Nov-10	8	5	0	13	1	0	0	1	31	55	2	88	6	13	1	20
Nov-12	5	15	1	21	0	0	1	1	24	36	6	66	4	12	3	19
Nov-13	5	11	0	16	1	1	0	2	31	54	8	93	10	14	4	28
Nov-17	2	12	1	15	1	0	0	1	13	43	5	61	1	13	1	15
Nov-19	4	2	0	6	0	0	0	0	10	17	1	28	3	5	0	8
Nov-20	0	1	0	1	0	0	0	0	8	15	2	25	1	3	1	5
Nov-24									3	3	0	6	1	1	0	2
Nov-25									0	1	0	1	0	1	0	1
Nov-27									3	3	0	6	1	1	0	2
Total	107	170	7	284	20	30	2	52	494	627	58	1179	123	175	14	312

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack , T = total

Appendix C8. Total dead recovery and adipose clip recovery in Quinsum River, 1987 (a).

Date	Area 2B								Area 2C								Area 2D							
	Total recovered (b)				Adipose clipped recovered				Total recovered				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-19	0	0	0	0	0	0	0	0	0	1	1	2	0	0	1	1	0	0	1	1	0	0	0	0
Oct-21	0	1	0	1	0	1	0	1	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Oct-26	1	2	0	3	0	0	0	0	1	15	2	18	0	2	1	3	2	8	0	10	1	3	0	4
Oct-29	0	2	2	4	0	1	1	2	4	14	3	21	0	4	2	6	5	9	1	15	2	3	0	5
Nov-02	3	9	6	18	2	3	1	6	7	41	14	62	1	21	4	26								
Nov-03	0	3	0	3	0	3	0	3	11	38	17	66	2	10	4	16	4	7	2	13	2	4	0	6
Nov-05	6	11	21	38	1	3	5	9	17	42	24	83	6	15	5	26	8	20	2	30	4	6	0	10
Nov-06																	8	23	7	38	3	12	2	17
Nov-09	8	13	40	61	2	4	4	10	17	50	47	114	4	12	4	20	19	17	8	44	2	8	2	12
Nov-11	3	8	16	27	0	3	3	6	12	19	23	54	3	6	4	13	17	25	8	50	5	8	2	15
Nov-12																	8	13	1	22	2	3	0	5
Nov-16	4	9	10	23	0	2	0	2	12	29	29	70	2	6	2	10	20	22	13	55	7	9	3	19
Nov-19	0	2	2	4	0	0	1	1	11	30	8	49	1	7	1	9	12	27	10	49	2	6	2	10
Nov-20									4	23	6	33	2	8	0	10	3	1	4	8	1	0	0	1
Nov-23	0	2	1	3	0	0	1	1	5	10	3	18	0	0	1	1	2	10	1	13	2	4	0	6
Nov-26									3	8	4	15	0	0	0	0	6	13	2	21	2	2	1	5
Nov-30									5	8	1	14	1	1	0	2	0	1	0	1	0	1	0	1
Total	25	62	98	185	5	20	16	41	109	330	182	621	22	92	29	143	114	196	60	370	35	69	12	116

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack , T = total

APPENDIX D

Release and recovery data for Campbell and Quinsam rivers, 1988

Appendix D1. Release of tagged chinook salmon carcasses in Campbell River, 1988.

Date	Release area (a)	Released			
		Males	Females	Jacks	Total
Oct-17	1A	0	0	0	0
	1B	0	2	1	3
Oct-18	1A	3	0	0	3
	1B	4	4	0	8
Oct-20	1A	0	2	0	2
	1B	4	2	1	7
Oct-21	1A	1	1	0	2
	1B	2	2	1	5
Oct-25	1A	2	0	0	2
	1B	26	27	3	56
Oct-26	1A	5	4	0	9
	1B	0	1	1	2
Oct-27	1A	0	0	0	0
	1B	2	7	0	9
Oct-28	1A	1	2	2	5
	1B	19	10	1	30
Oct-31	1A	12	5	0	17
	1B	2	4	2	8
Nov-01	1A	0	4	1	5
	1B	14	26	1	41
Nov-02	1A	1	2	0	3
	1B	0	2	0	2
Nov-04	1A	0	2	0	2
	1B	25	54	2	81
Nov-08	1A	0	2	0	2
	1B	13	22	0	35
Nov-09	1A	4	3	0	7
	1B	4	11	1	16
Nov-10	1A	0	0	0	0
	1B	8	11	2	21
Nov-15	1A	0	1	0	1
	1B	10	22	1	33
Nov-16	1A	1	3	0	4
	1B	6	3	2	11
Nov-18	1A	0	0	0	0
	1B	3	5	0	8
Nov-21	1A	0	0	0	0
	1B	5	3	0	8
Nov-23	1A				
	1B	1	1	0	2
	Total	178	250	22	450

(a) See Fig. 1 for location of release areas

Appendix D2. Release of tagged chinook salmon carcasses in Quinsam River, 1988.

Date	Release area (a)	Released			
		Males	Females	Jacks	Total
Oct-17	2B	2	1	1	4
	2C	5	4	0	9
	2D	3	4	0	7
Oct-19	2B	3	1	0	4
	2C	3	4	2	9
	2D	3	1	0	4
Oct-24	2B	15	7	7	29
	2C	18	9	4	31
	2D	3	2	1	6
Oct-26	2B	9	3	3	15
	2C	7	2	4	13
	2D	0	0	0	0
Oct-27	2B	0	0	0	0
	2C	5	13	3	21
	2D	2	15	0	17
Oct-31	2B	30	19	8	57
	2C	5	18	0	23
	2D				
Nov-01	2B				
	2C	10	15	12	37
	2D	13	17	2	32
Nov-02	2B				
	2C				
	2D	1	1	0	2
Nov-03	2B	5	0	1	6
	2C	4	4	4	12
	2D	7	6	2	15
Nov-07	2B	1	1	1	3
	2C	1	4	2	7
	2D	2	7	1	10
Nov-11	2B	3	7	2	12
	2C	5	17	0	22
	2D	8	4	0	12
Nov-14	2B	6	11	0	17
	2C	22	48	2	72
	2D	8	11	0	19
Nov-15	2B				
	2C	14	31	0	45
	2D				
Nov-17	2B	9	24	1	34
	2C	38	57	1	96
	2D				
Nov-18	2B				
	2C	8	24	2	34
	2D	25	18	0	43
Nov-22	2B	5	2	0	7
	2C	8	14	0	22
	2D	4	5	0	9
Nov-24	2B	3	9	0	12
	2C	19	21	1	41
	2D				
Nov-25	2B				
	2C				
	2D	4	3	0	7
Nov-26	2B				
	2C				
	2D	10	4	0	14
Nov-30	2B	13	11	0	24
	2C	11	22	1	34
	2D				
Dec-01	2B				
	2C	4	5	0	9
	2D				
Dec-02	2B	3	2	0	5
	2C	0	0	0	0
	2D	2	3	0	5
Dec-05	2B	0	1	1	2
	2C	0	3	1	4
	2D	0	0	0	0
	Total	389	515	70	974

(a) See Fig. 1 for location of release areas

Appendix D3. Dead recovery of tagged chinook salmon carcasses in Campbell River, 1988.

Date	Recovery area (a)	Recovered			
		Males	Females	Jacks	Total
Oct-20	1A	2	0	0	2
	1B	0	1	0	1
Oct-21	1A	0	0	0	0
	1B	1	1	0	2
Oct-25	1A	0	1	0	1
	1B	2	2	0	4
Oct-26	1A	0	0	0	0
	1B	1	0	0	1
Oct-27	1A	0	0	0	0
	1B	0	3	0	3
Oct-28	1A	2	0	0	2
	1B	11	7	0	18
Oct-31	1A	0	4	0	4
	1B	0	1	0	1
Nov-01	1A	2	1	1	4
	1B	6	4	0	10
Nov-02	1A	6	3	1	10
	1B	0	1	0	1
Nov-04	1A	0	0	0	0
	1B	12	25	0	37
Nov-08	1A	0	0	0	0
	1B	7	7	0	14
Nov-09	1A	1	0	0	1
	1B	12	14	2	28
Nov-10	1A	0	0	0	0
	1B	0	2	0	2
Nov-15	1A	0	0	0	0
	1B	4	8	0	12
Nov-16	1A	0	0	0	0
	1B	0	2	0	2
Nov-18	1A	0	1	0	1
	1B	4	7	0	11
Nov-21	1A	0	1	0	1
	1B	1	3	0	4
Nov-23	1A				
	1B	0	1	0	1
Nov-25	1A				
	1B	2	2	0	4
Nov-29	1A				
	1B	1	0	0	1
	Total	77	102	4	183

(a) See Fig. 1 for location of recovery areas

Appendix D4. Dead recovery of tagged chinook salmon carcasses in Quinsam River, 1988.

Date	Recovery area (a)	Recovered				Date	Recovery area	Recovered			
		Males	Females	Jacks	Total			Males	Females	Jacks	Total
Oct-19	2B	0	0	0	0	Nov-15	2B				
	2C	1	1	0	2		2C	6	4	1	11
	2D	0	0	0	0		2D				
Oct-24	2B	1	1	0	2	Nov-17	2B	0	3	0	3
	2C	1	2	0	3		2C	27	50	0	77
	2D	0	0	0	0		2D				
Oct-26	2B	9	6	3	18	Nov-18	2B				
	2C	3	0	1	4		2C	1	1	0	2
	2D	0	0	0	0		2D	8	9	0	17
Oct-27	2B	0	0	0	0	Nov-22	2B	1	6	0	7
	2C	4	3	2	9		2C	0	3	0	3
	2D	4	1	0	5		2D	4	7	0	11
Oct-31	2B	8	2	0	10	Nov-24	2B	0	4	0	4
	2C	6	7	0	13		2C	6	12	0	18
	2D						2D				
Nov-01	2B	0	0	0	0	Nov-26	2B				
	2C	8	8	1	17		2C				
	2D	2	7	1	10		2D	6	7	0	13
Nov-02	2B					Nov-30	2B	2	2	0	4
	2C	0	0	0	0		2C	15	16	0	31
	2D	0	3	0	3		2D				
Nov-03	2B	3	0	1	4	Dec-01	2B				
	2C	3	3	1	7		2C	10	22	0	32
	2D	2	6	0	8		2D				
Nov-07	2B	1	0	0	1	Dec-02	2B	8	8	0	16
	2C	0	1	0	1		2C	0	0	0	0
	2D	1	1	0	2		2D	6	6	0	12
Nov-11	2B	2	3	1	6	Dec-05	2B	0	0	0	0
	2C	0	0	0	0		2C	2	16	0	18
	2D	2	3	0	5		2D	0	0	0	0
Nov-14	2B	1	4	0	5	Dec-09	2B	0	0	0	0
	2C	5	7	0	12		2C	1	2	0	3
	2D	4	3	0	7		2D	0	0	0	0
							Total	174	250	12	436

(a) See Fig. 1 for location of recovery areas

Appendix D5. Sequential mark-recapture data for chinook salmon carcasses in Campbell River, 1988. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR). Numbers in bold are incorrect and underestimate the true number of fish examined (could not be verified).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-03	1	0	0	1	0	0	0	0	0	2	0	0
Oct-05	0	0	0	1	0	0	0	0	0	1	0	0
Oct-17	3	0	0	3	2	0	1	1	0	7	3	0
Oct-18	18	7	0	7	4	0	1	0	0	26	11	0
Oct-20	16	4	2	5	4	1	3	1	0	24	9	3
Oct-21	14	3	1	4	3	1	1	1	0	19	7	2
Oct-25	70	28	2	62	27	3	11	3	0	143	58	5
Oct-26	13	5	1	11	5	0	3	1	0	27	11	1
Oct-27	13	2	0	18	7	3	1	0	0	32	9	3
Oct-28	57	20	13	38	12	7	8	3	0	103	35	20
Oct-31	34	14	0	25	9	5	7	2	0	66	25	5
Nov-01	43	14	8	50	30	5	7	2	1	100	46	14
Nov-02	**5**	1	6	**6**	4	4	1	0	1	12	5	11
Nov-04	67	25	12	110	56	25	12	2	0	189	83	37
Nov-08	31	13	7	52	24	7	5	0	0	88	37	14
Nov-09	21	8	13	**24**	14	14	3	1	2	48	23	29
Nov-10	21	8	0	32	11	2	5	2	0	58	21	2
Nov-15	28	10	4	46	23	8	5	1	0	79	34	12
Nov-16	14	7	0	17	6	2	2	2	0	33	15	2
Nov-18	**6**	3	4	12	5	8	0	0	0	18	8	12
Nov-21	10	5	1	11	3	4	0	0	0	21	8	5
Nov-23	4	1	0	8	1	1	1	0	0	13	2	1
Nov-25	11	0	2	6	0	2	1	0	0	18	0	4
Nov-29	3	0	1	4	0	0	0	0	0	7	0	1
Totals	503	178	77	553	250	102	78	22	4	1134	450	183
Totals for MR (a)	481	178	77	548	250	102	77	22	4	1106	450	183

(a) To be used in the Peterson population estimation procedure for the carcass tagging and recovery method; the larger totals are to be used for the live tagging and recovery method

Appendix D6. Sequential mark-recapture data for chinook salmon carcasses in Quinsam River, 1988. Carcasses examined on or before the first date of tagging are not included in the number examined for the mark-recapture estimate (MR). Numbers in bold are incorrect and underestimate the true number of fish examined (could not be verified).

Date	Males			Females			Jacks			Total		
	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries	No. examined	No. Tags applied	No. recoveries
Oct-17	23	10	0	22	9	0	4	1	0	49	20	0
Oct-19	23	9	1	15	6	1	4	2	0	42	17	2
Oct-24	103	36	2	45	18	3	35	12	0	183	66	5
Oct-26	42	16	12	**9**	5	6	18	7	4	69	28	22
Oct-27	39	7	8	43	28	4	11	3	2	93	38	14
Oct-31	105	35	14	63	37	9	28	8	0	196	80	23
Nov-01	84	23	10	53	32	15	25	14	2	162	69	27
Nov-02	1	1	0	**2**	1	3	2	0	0	5	2	3
Nov-03	36	16	8	25	10	9	17	7	2	78	33	19
Nov-07	15	4	2	29	12	2	6	4	0	50	20	4
Nov-11	39	16	4	61	28	6	12	2	1	112	46	11
Nov-14	102	36	10	137	70	14	9	2	0	248	108	24
Nov-15	43	14	6	57	31	4	4	0	1	104	45	11
Nov-17	112	47	27	199	81	53	10	2	0	321	130	80
Nov-18	72	33	9	95	42	10	2	2	0	169	77	19
Nov-22	41	17	5	37	21	16	4	0	0	82	38	21
Nov-24	51	22	6	69	30	16	2	1	0	122	53	22
Nov-25	0	4	0	0	3	0	0	0	0	0	7	0
Nov-26	19	10	6	12	4	7	0	0	0	31	14	13
Nov-30	68	24	17	75	33	18	4	1	0	147	58	35
Dec-01	17	4	10	**24**	5	22	2	0	0	43	9	32
Dec-02	**15**	5	14	**17**	5	14	1	0	0	33	10	28
Dec-05	4	0	2	**10**	4	16	2	2	0	16	6	18
Dec-09	4	0	1	6	0	2	0	0	0	10	0	3
Totals	1058	389	174	1105	515	250	202	70	12	2365	974	436
Totals for MR (a)	1035	389	174	1083	515	250	198	70	12	2316	974	436

(a) To be used in the Petersen population estimation procedure for the carcass tagging and recovery method; the larger totals are to be used for the live tagging and recovery method.

Appendix D7. Total dead recovery and adipose clip recovery of chinook salmon in Campbell River, 1988 (a).

Date	Area 1A								Area 1B							
	Total recovered (b)				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-03	0	0	0	0	0	0	0	0	1	1	0	2	1	0	0	1
Oct-05	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Oct-17	0	0	0	0	0	0	0	0	3	3	1	7	0	1	0	1
Oct-18	7	1	0	8	1	0	0	1	11	6	1	18	0	1	0	1
Oct-20	5	2	0	7	1	0	0	1	11	3	3	17	2	0	0	2
Oct-21	1	1	0	2	0	0	0	0	13	3	1	17	2	0	0	2
Oct-25	5	0	0	5	0	0	0	0	65	62	11	138	9	8	2	19
Oct-26	12	8	1	21	1	0	0	1	1	3	2	6	1	1	1	3
Oct-27	1	2	0	3	1	2	0	3	12	16	1	29	6	4	0	10
Oct-28	7	3	3	13	0	0	0	0	50	35	5	90	1	5	0	6
Oct-31	27	14	2	43	4	0	0	4	7	11	5	23	0	2	0	2
Nov-01	0	0	0	0	0	0	0	0	43	50	7	100	3	3	0	6
Nov-02	2	4	1	7	0	1	0	1	3	2	0	5	1	0	0	1
Nov-04	1	4	0	5	1	0	0	1	66	106	12	184	7	12	2	21
Nov-08	1	3	0	4	1	0	0	1	30	49	5	84	2	8	1	11
Nov-09	6	9	0	15	0	1	0	1	15	15	3	33	3	1	0	4
Nov-10	0	0	0	0	0	0	0	0	21	32	5	58	2	7	1	10
Nov-15	0	1	0	1	0	0	0	0	28	45	5	78	4	8	0	12
Nov-16	1	8	0	9	0	1	0	1	13	9	2	24	1	2	0	3
Nov-18	0	0	0	0	0	0	0	0	6	12	0	18	0	1	0	1
Nov-21	1	1	0	2	0	0	0	0	9	10	0	19	0	0	0	0
Nov-23									4	8	1	13	0	2	0	2
Nov-25									11	6	1	18	1	0	0	1
Nov-29									3	4	0	7	0	1	0	1
Total	77	61	7	145	10	5	0	15	426	492	71	989	46	67	7	120

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack, T = total

Appendix D8. Total dead recovery and adipose clip recovery in Quinsam River, 1988 (a).

Date	Area 2B								Area 2C								Area 2D							
	Total recovered (b)				Adipose clipped recovered				Total recovered				Adipose clipped recovered				Total recovered				Adipose clipped recovered			
	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T	M	F	J	T
Oct-17	4	4	1	9	0	1	0	1	10	12	1	23	2	2	0	4	9	6	2	17	0	1	0	1
Oct-19	8	3	0	11	1	0	0	1	9	9	3	21	0	2	0	2	6	3	1	10	1	1	0	2
Oct-24	33	12	19	64	0	1	2	3	61	28	14	103	5	4	2	11	9	5	2	16	1	2	0	3
Oct-26	24	5	7	36	4	1	0	5	18	4	11	33	1	1	2	4	0	0	0	0	0	0	0	0
Oct-27	0	0	0	0	0	0	0	0	21	23	7	51	2	4	1	7	18	20	4	42	4	1	1	6
Oct-31	81	33	21	135	9	4	0	13	24	30	7	61	5	5	1	11								
Nov-01	1	1	0	2	0	1	0	1	42	25	18	85	2	4	1	7	41	27	7	75	4	5	0	9
Nov-02									0	1	0	1	0	0	0	0	1	1	2	4	0	0	0	0
Nov-03	10	3	2	15	1	1	0	2	12	8	9	29	0	2	1	3	14	14	6	34	1	2	0	3
Nov-07	4	6	1	11	0	2	0	2	6	6	2	14	1	1	0	2	5	17	3	25	0	3	0	3
Nov-11	8	14	4	26	1	0	0	1	15	38	0	53	0	5	0	5	16	9	8	33	3	0	1	4
Nov-14	16	29	0	45	2	3	0	5	64	95	5	164	10	8	1	19	22	13	4	39	1	2	1	4
Nov-15									43	57	4	104	2	9	0	11								
Nov-17	26	50	3	79	1	6	0	7	86	149	7	242	7	17	1	25								
Nov-18									20	49	2	71	0	2	0	2	52	46	0	98	5	4	0	9
Nov-22	7	8	1	16	0	1	0	1	24	20	3	47	0	0	0	0	10	9	0	19	0	1	0	1
Nov-24	9	17	1	27	1	0	0	1	42	52	1	95	3	3	0	6								
Nov-26																	19	12	0	31	1	0	0	1
Nov-30	29	30	1	60	5	2	0	7	39	45	3	87	9	5	0	14								
Dec-01									17	24	2	43	4	5	1	10								
Dec-02	5	8	1	14	0	1	0	1	0	0	0	0	0	0	0	0	10	9	0	19	2	1	0	3
Dec-05	2	4	1	7	1	1	0	2	2	6	1	9	0	0	0	0	0	0	0	0	0	0	0	0
Dec-09	1	0	0	1	0	0	0	0	3	6	0	9	0	0	0	0	0	0	0	0	0	0	0	0
Total	268	227	63	558	26	25	2	53	558	687	100	1345	53	79	11	143	232	191	39	462	23	23	3	49

(a) See Fig. 1 for location of recovery areas

(b) Abreviations are M = male, F = female, J = jack, T = total